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OUR CONTRIBUTORS

Dr. Rasmussen for the last 25 years has studied the life of the Eskimo and explored northern lands. On the First Thule Expedition he twice crossed northern Greenland over the inland ice. An account of the Second Thule Expedition appeared in the *Geographical Review*, Vol. 8, 1919. In recognition of his notable work he was recently awarded the Charles P. Daly Medal of the American Geographical Society (see the July number). Dr. Rasmussen's best-known works are "The People of the Polar North" (1908), "Greenland by the Polar Sea" (1921), and "Eskimo Folk Tales" (1921).

Dr. Rasmussen's assistants contributing to the present article are Messrs. Freuchen, Birket-Smith, and Mathiassen. The first-named was also cartographer on the First Thule Expedition; Birket-Smith has made extensive ethnological studies of the Eskimo and has also studied contiguous tribes of North American Indians; Mathiassen was archeologist and cartographer to the expedition.

Dr. Valkenberg is head of the cartographic section of the Topographical Service of the Netherlands East Indies. He has charge of economic and commercial as well as topographical maps and takes part in the supervision of geographical work in the Javanese schools. He has traveled extensively in the Netherlands East Indies.

Mr. Impey, an English engineer at present in China, made his examination of the site of Shangtu in May and June of 1924. He was deeply impressed with its archeological importance and urges a thorough-going exploration at the earliest opportunity.

Mr. Hovgaard, sometime commander in the Danish Royal Navy, is professor of naval design and construction at the Massachusetts Institute of Technology. He is a keen student of the problems of the early Norse voyages and the author of "The Voyages of the Norsemen to America" (1914).

Dr. Marbut, in charge of soil survey of the Bureau of Soils, U. S. Department of Agriculture, has a special interest in the application of physiography to the distribution and use of soils. He is co-author of "The Vegetation and Soils of Africa," *Amer. Geogr. Soc. Research Ser. No. 13*, 1923. Dr. Marbut was President of the Association of American Geographers for 1924 and gave as his presidential address a paper entitled "The Rise, Decline, and Revival of Malthusianism in Relation to Geography and Character of Soils," published in the *Annals*, March, 1925.

Mr. Manifold of the Bureau of Soils has had wide experience in the study of soils in all parts of the United States and was associated with Dr. Marbut in the Amazon basin work as a member of the Crude Rubber Survey of the Department of Commerce.

Dr. Koch has been engaged in geographical and geological investigations in northern Greenland since 1916. He acted as topographer and geologist to the Second Thule Expedition and was leader of the Bicentenary Expedition (1920–1923) on which notable scientific results, now in course of publication, were achieved. Plans for Dr. Koch's forthcoming expedition (1926) to eastern Greenland and across the inland ice are given in the June number of the *Geografisk Tidskrift*.

Mr. Balch is a Councilor of the American Geographical Society. His studies embrace mountaineering, Polar exploration, and the bearing of art on comparative ethnology. He has done much toward promoting a knowledge of the important share that Americans, notably Wilkes and Palmer, have done in the exploration of the Antarctic. Some of Mr. Balch's numerous publications are: "Antarctica" (1902); "Stonington [Conn.] Antarctic Explorers" (*Bull. Amer. Geogr. Soc.*, Vol. 41, 1909, pp. 473–492); "Glacières, or Freezing Caverns" (1900); "Comparative Art" (1906); "Arts of the World" (1920).

THE
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THE DANISH ETHNOGRAPHIC AND GEOGRAPHIC EXPEDITION TO ARCTIC AMERICA

PRELIMINARY REPORT OF THE FIFTH THULE EXPEDITION*

By KNUD RASMUSSEN

WITH THE COLLABORATION OF HIS ASSOCIATES

[With separate map, Pl. IV, facing p. 562]

Study of the Eskimos is a natural problem for Denmark. We have now for over two hundred years held the fate of the Eskimos of Western Greenland in our hand,[1] and the opinion of the civilized world regarding Eskimo civilization has to a great extent been based upon the literary and scientific works of Danes. The classics of the eighteenth century in this field are nearly all Danish. The first detailed description of an Eskimo tribe is the well-known account of Hans Egede, and few have succeeded in entering into the spirit and thought of the Eskimos to such a degree as did his son Paul.[2]

In Glahn's Diaries and Dalager's "Relationer" there is invaluable material on the Greenlanders of the eighteenth century while the descriptions of hunting equipment and methods by Otho Fabricius are so detailed and accurate that modern ethnography cannot better them.[3] In the nineteenth century the foundations for scientific study of the Eskimo were laid down by Rink, who was the first to make a systematic collection of Eskimo

*For translation of the larger part of the manuscript from the Danish the Society is indebted to Miss Elinor Bech of the Consulate General of Denmark, New York.

[1] The whole of Greenland was proclaimed a Danish colony in 1921.

[2] Hans Egede: Det gamle Grønlands nye Perlustration eller Naturelhistorie, Copenhagen, 1729 and 1741. English transl., "A Description of Greenland," London, 1745.

Paul Egede: Efterretningen om Grønland, Copenhagen, 1788.

Niels Egede, a brother of the latter, also published an interesting journal of his Greenlandic experiences.

[3] H. C. Glahn's Dagbøger (Det grønlandske Selskabs Skrifter Vol. 5, Copenhagen, 1921).

Lars Dalager: Grønlandske Relationer, Copenhagen, 1752.

Otho Fabricius, in *Kongelige Danske Videnskabernes Selskabs Skrivter*, Copenhagen, Vol. 5, 1810, and Vol. 6, 1818.

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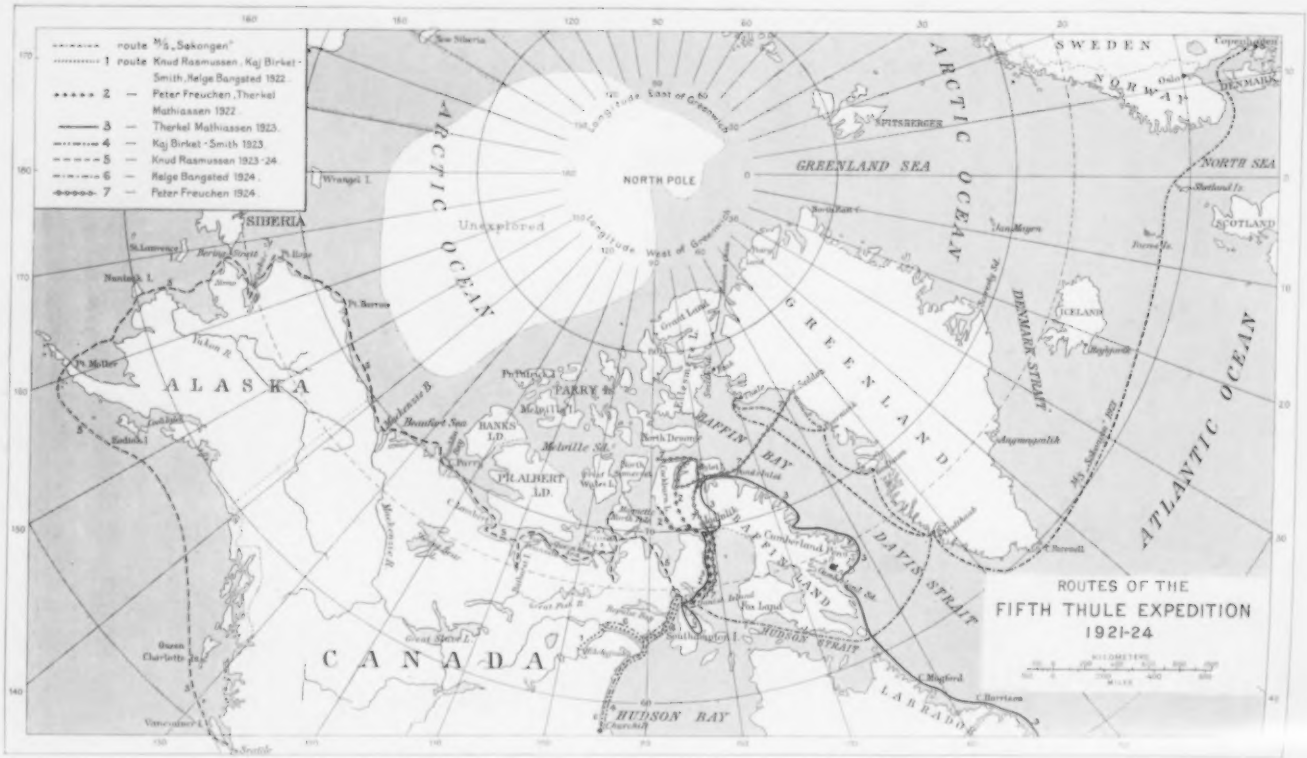

route "M/s. Søkongen"
1 route Knud Rasmussen, Kaj Birket-Smith, Helge Bangsted 1922.
2 — Peter Freuchen, Therkel Mathiassen 1922.
3 — Therkel Mathiassen 1923.
4 — Kaj Birket-Smith 1923.
5 — Knud Rasmussen 1923-24.
6 — Helge Bangsted 1924.
7 — Peter Freuchen 1924.
ROUTES OF THE
FIFTH THULE EXPEDITION
1921-24
NORTH POLE
Unexplored
ARCTIC OCEAN
GREENLAND SEA
ARCTIC OCEAN
SWEDEN
NORWAY
DENMARK
NORTH SEA
SPITSBERGEN
SIBERIA
ALASKA
CANADA
GREENLAND
ICELAND
DENMARK STRAIT
ATLANTIC OCEAN
BAFFIN BAY
DAVIS STRAIT
HUDSON STRAIT
HUDSON BAY
LABRADOR
BAFFIN LAND
PARRY Is.
BANKS LD.
MELVILLE Is.
PEARY LD.
Wrangel I.
Nunivak I.
Kodiak I.
Queen Charlotte Is.
Vancouver I.
Seattle
Churchill
Mingan
Chateau
Angmagssalik
Godthaab
Thorshavn
Lerwick
Shetland Is.
Copenhagen
Oslo
Stockholm
Reykjavik
Jan Mayen
Bear I.
Beaufort Sea
Melville Sd.
Barrow
Point Hope
Point Barrow
Point Barrow
Cape Parry
Cape Sabine
Cape Sparbo
Cape Herschel
Cape Dyer
Cape Walsingham
Cape Chidley
Cape Farewell
Cape Wrangel
Cape Prince of Wales
Cape Lisburne
Cape Barrow
Cape Bathurst
Cape Kellett
Cape Parry
Cape Alexander
Cape Sabine
Cape Isachsen
Cape Columbia
Cape Sheridan
Cape Hecla
Cape Fullerton
Cape Dorset
Cape Mercy
Cape Wolstenholme
Cape Chidley
Cape Farewell
Cape Walsingham
Cape Dyer
Cape Herschel
Cape Isachsen
Cape Sabine
Cape Sparbo
Cape Hecla
Cape Columbia
Cape Sheridan

legends and also the first to undertake comparative investigations into the origin and development of the Eskimos.[4]

Gustav Holm has given a description of the hitherto unknown civilization of the Eskimos of Angmagssalik on the east coast of Greenland in a volume which is universally acknowledged a model ethnographic monograph.[5] William Thalbitzer is the first who has made use of modern, phonetic methods in studying the language of the Eskimos.[6] The late Professor Steensby has made geographic investigations on the adjustment of the various types of Eskimo civilization to natural conditions. His work led up to the hypothesis regarding the origin of Eskimo civilization which may be said to be the foundation of this expedition.[7]

The Eskimos Outside Greenland

The Eskimos, however, also occupy a vast territory outside of Greenland, including the long stretch of Arctic coasts from Davis Strait to the Pacific Ocean. Here a number of American and British travelers and explorers have taken up the problem. We meet here all the great names from the days of the Northwest expeditions: Ross, Franklin, Back, Dease and Simpson, Rae, M'Clintock, M'Clure, Collinson, and in our day the Norwegian explorer Amundsen. Probably none of these travelers gave particular attention to the inhabitants of the country, but there exist valuable observations from all of them. I wish, however, to lay particular stress on a few travelers from the district around our headquarters, in particular Parry and Lyon. The work of these two British naval officers is distinguished by an accurateness and a wealth of observation which is highly appreciated by one who has traveled in the same sections.[8] Furthermore, mention should be made of two Americans; namely, Schwatka, who was the leader of the American Geographical Society's first Arctic expedition and who first mentions the peculiar inland tribes of the Barren Grounds; and Charles F. Hall, whose maps of Melville Peninsula do not seem to be sufficiently appreciated.[9]

The most valuable ethnographic material on the Eskimos outside of Greenland is found in a series of monographs proceeding from the Bureau of Ethnology in Washington and the American Museum of Natural History

[4] Henrik Rink: Eskimoiske Eventyr og Sagn, 2 vols., Copenhagen, 1866 and 1871; *idem:* The Eskimo Tribes, *Meddelelser om Grønland*, Vol. 11, 1893.

[5] Gustav Holm: Ethnologisk Skizze af Angmagsalikerne, pp. 43–182 in Den østgrønlandske Expedition udført i Aarene 1883–85, *Meddelelser om Grønland*, Vol. 10, 1888; English transl., *ibid.*, Vol. 39, 1914, pp. 3–147.

[6] William Thalbitzer: A Phonetical Study of the Eskimo Language, *Meddelelser om Grønland*, Vol. 31, 1904.

[7] H. P. Steensby: Om Eskimokulturens Oprindelse, Copenhagen, 1905; revised English transl. in *Meddelelser om Grønland*, Vol. 53, 1916.

[8] W. E. Parry: Journal of a Second Voyage for the Discovery of a North-West Passage . . . in the Years 1821–22–23, London, 1824.

G. F. Lyon: Private Journal, London, 1824.

[9] W. H. Gilder: Schwatka's Search, New York, 1881. A short account of Schwatka's expedition appears in the "Arctic Meeting for the Reception of Lieut. Schwatka and His Associates of the Franklin Search Party of 1878–'79–'80," *Journ. Amer. Geogr. Soc.*, Vol. 12, 1880, pp. 237–274.

J. E. Nourse, edit.: Narrative of the Second Arctic Expedition Made by Charles F. Hall . . . During the Years 1864–'69, U. S. Naval Observatory, Washington, 1879.

in New York. Here may be mentioned the writings of Turner on Ungava Bay, of Murdoch on Point Barrow, and of Nelson on Bering Strait,[10] but above all the writings of Franz Boas.[11] Mention too should be made of his organization of the Jesup North Pacific Expedition, the object of which was to study the relationship between the civilization of northeastern Asia and of North America. Finally it must not be forgotten that latterly Canada has also taken an active part in the work by sending out the Canadian Arctic Expedition under the leadership of Vilhjalmur Stefansson. The writings of Stefansson himself as well as the descriptions of the Copper Eskimos by Jenness are of importance in Eskimo literature.[12]

Organization of the Fifth Thule Expedition

There were, however, problems enough left, and, wishful to contribute toward their solution and also to bring Danish ethnographical study into closer contact with American and Canadian science, the Fifth Thule Expedition was organized under the aegis of His Majesty the King of Denmark and at the expense of the Danish Government and the trading station of Thule.[13]

The Expedition started in the summer of 1921 on board the "Søkongen" commanded by Captain Peder M. Pedersen.[14] The members were: Peter Freuchen, cartographer and zoölogist, Therkel Mathiassen, archeologist and cartographer, Kaj Birket-Smith, ethnographer and geographer, Helge Bangsted, scientific assistant, Jacob Olsen, Greenlandic secretary and interpreter, and the leader, Knud Rasmussen, ethnographer and specialist in folklore. There were also six Cape York Eskimos, three of them women, whose special work was to free our time for scientific investigation by hunting and sewing, important matters in the Arctic sections. These Cape Yorkers gave splendid help and answered our expectations in every way. Leo Hansen later joined us on Kent Peninsula in 1923 as special moving picture photographer for the Expedition.

The objects of the Expedition were many and various, but the main purpose was a study of the Eskimos outside of Greenland from the standpoint of anthropology, archeology, ethnography, and especially folklore.

[10] John Murdoch: Ethnological Results of the Point Barrow Expedition, 9th Ann. Rept. Bur. of Amer. Ethnology for 1887–1888, pp. 3–441.

Lucien M. Turner: Ethnology of the Ungava District, Hudson Bay Territory, *ibid.*, 11th Ann. Rept. for 1889–1890, pp. 159–350.

Edward William Nelson: The Eskimo About Bering Strait, *ibid.*, 18th Ann. Rept. for 1896–1897, Part I, pp. 1–518.

[11] Franz Boas: The Central Eskimo, 6th Ann. Rept. Bur. of Amer. Ethnology for 1884–1885, pp. 399–669; *idem:* The Eskimo of Baffin Land and Hudson Bay, *Bull. Amer. Museum of Nat. Hist.*, Vol. 15, 1901–07.

[12] Vilhjalmur Stefansson: The Stefansson-Anderson Arctic Expedition of the American Museum: Preliminary Ethnological Report, *Anthropol. Papers Amer. Museum of Nat. Hist.*, Vol. 14, 1914, Part II; *idem:* My Life with the Eskimo, New York and London, 1913.

D. Jenness: The Life of the Copper Eskimos, *Rept. Canadian Arctic Expedition, 1913–18;* Vol. 12, Ottawa, 1922.

[13] Thule Station in North Star Bay was established by Rasmussen in 1910 for service to the Eskimos of this northerly region and as a base for Danish exploration. See Rasmussen's account of the Thule District in the Bicentennial Volume, *Meddelelser om Grønland*, Vol. 60, 1921.—Edit. Note.

[14] The Committee for the Expedition consisted of M. Ib Nyeboe (Chairman), C. Erichsen, Major J. P. Koch, Professors O. B. Bøggild, A. Jensen, and C. Ostenfeld and Museum Inspector T. Thomsen.

In addition mapping was of particular importance because a great part of the country through which we traveled was either entirely unknown or very inadequately mapped. A preliminary map showing the territory covered is given in Plate IV, facing p. 562: it includes northern Baffin Land, Melville Peninsula, and Southampton Island. Our program also included regular meteorological observations at headquarters and on our trips, and geological, zoölogical, and botanical collections and observations. The working up of the vast body of scientific data acquired will take long, but it is now possible to give an outline of the results and an indication of their quality. This is done in the following sections written by the several members of the expedition.

FIG. 2—Arnarulunguaq, Little Woman, the only Eskimo woman who has ever visited all the tribes of her own race. She made the whole journey from Greenland through the Northwest Passage to Alaska with the Fifth Thule Expedition.

FOLKLORE

By KNUD RASMUSSEN

Very little has heretofore been known of the social culture of the Eskimos outside of Greenland; and, furthermore, all explorers in this field have lacked the advantage given by an intimate knowledge of the Eskimo language. The study demanded that we should come in contact with as many tribes as possible, and it was primarily with this purpose in view that I undertook the long journey west to the Siberian coast (see Fig. 1).[15]

I shall here confine myself to a single aspect of the social culture which may seem a trifle specialized but which I have chosen because in a general way it shows the relationship which exists between all Eskimos from Greenland to Alaska. This is the belief that forms the basis of their entire view of life, as expressed through the mystical power *Sila* and the use of amulets.

[15] The wealth of material obtained includes data on the Aivilik and Iglulik and Barren Ground Eskimos; material for monographs on the Netsilik Eskimos between Bellot Strait and Adelaide Peninsula, and on the Umingmagtormiut (the people of the musk oxen), northeast of the mouth of Bathurst Inlet; information from the tribes between Coronation Gulf and Victoria Land; comparatively complete data on old hunting traditions and folklore from the original inhabitants of the region between Bailey Island and the Mackenzie Delta and from the Alaskan Eskimos, especially the former inland inhabitants between Colville River and Kotzebue Sound; general information on the Eskimos in Bering Strait and about East Cape, and descriptions of specially characteristic ceremonies on Nunivak Island.

The Power Sila

It is difficult to define Sila, difficult even to translate the word because we lack the basal conceptions. However, we may say that it has a threefold significance—the universe, the weather, and an expression compounded of common sense, intelligence, and wisdom.

Let us take by way of explanation and illustration the beliefs held by the Caribou Eskimos on the Barren Grounds. Here the word Sila (hila) is

Fig. 3—Miteq (Eiderduck) returns from a successful caribou hunt. He also accompanied Rasmussen on the long western journey.

used for a power personified by Hilap-inua or pinga, a woman. She is regarded not so much in the light of a creator of human beings or game as feared as a strict housekeeper, in particular with regard to the way in which game is treated. She is present everywhere and makes herself known when there is reason for her interference. The daily food must be treated with respect. When a caribou is killed, certain ceremonies must be observed to show honor to the killed animal, and at the same time everything which is not taken must be carefully covered. Sila must not see anything wasted.

The taboo system of the Caribou Eskimos is not as complicated and varied as that of the coast dwellers, but it is interesting to us in this connection because all taboo is in reference to Sila. Although the conditions Sila makes for man cannot be said to be difficult, she punishes their transgression with a terrible, powerful force—she sends bad weather or sickness, drives away the game from the hunting grounds—in fact, all those catastrophes which are most feared. Simple as is the basal thought the whole relation shows an unconscious wisdom which can only command our respect.

Sila has also another and different function, which I will illustrate by an experience on leaving my camp at Hikuligjuaq at an unfortunate time of

year, the spring breakup when as a rule no one travels. As an expression of the friendliness of the settlement toward the Expedition it was planned that one of their most important conjurors should get into touch with his helping spirits to smooth the way for me. As many people as possible were collected in a large tent; when the seance started I was requested to go outside and sit down in the snow where there were no footmarks. As the conjuror explained, I had to do this: *hilap takuniarmatit, hilap isiginiarmatit,*

FIG. 4—One of the dog teams of the expedition, which made the whole sledge journey from 1921 to 1924.

Sila must see me while the conjuror did what he could to rid my path of obstacles.

On this occasion I came face to face with an entirely new function of Sila, the good Sila, who was called in to help one who could not help himself. Otherwise the supernatural powers are only considered revengeful and all the religious endeavors of man are for the purpose of keeping them at a distance.

NULIAJUK OF THE COAST

It may here be remarked that among the coast dwellers the personification of Hilap-inua has become Nuliajuk, the woman, who, as mother of the sea animals and ruler over man's game lives on the bottom of the ocean. She is kept at a distance through an extraordinarily complicated taboo system. They seek to neutralize her powers for those sides of Sila which speak through the weather and which are man's greatest fear on earth.

Through all the Eskimo tribes the legend regarding Nuliajuk is the same and tells of a young orphan girl who was thrown into the ocean and since in some mystic way has settled on the bottom. The various smaller and

larger varieties of seal were created from the joints of her fingers which were chopped off her hands when she tried to hold on to the kayaks.

I questioned an old Netsilik Eskimo who narrated the legend:

"What existed before Nuliajuk?"

To this he answered very logically: "No taboo, but also there was no game."

"Then what did man live on?"

He answered: "The first men lived on earth. When they pitched camp and took over new land, they always started to dig in the ground where they looked for food."

"But where did they get blubber for their lamps?"

"At that time *aqerdlorqaq*, new drifts after a snow fall, might light up, but out under the open sky there was always black darkness; there was no light in the world."

The Conjuror of Nunivak Island

I could take the reader from settlement to settlement, not only from Hudson Bay but through the entire Northwest Passage to Alaska and everywhere find parallels to what have been described. Similar parallels exist for Greenland if we go back to the time before Christianity was known.[16] It would take too long to follow this thought out so I shall content myself here by going to Nunivak Island northwest of Kuskokwim Bay where the inhabitants are still entirely primitive and up to the last two years had not been influenced at all from outside.

Here I met an unusually intelligent conjuror by the name of Najagneq with whom I had a long discussion on the higher problems of life. He told me that his faith was concentrated on a strong spirit, Slam-jua, so powerful that he did not speak to man through ordinary words but through storms, snow, rain, the unrest of the ocean—through all the forces which man fears. This is Slam-jua's ordinary means of communication. But he also has another way of expressing himself—through the very young. Najagneq emphasized very strongly this contrast in the medium of expression—the unpent wildness of the weather, the innocence of a child. The children hear a small and careful voice, something like a woman's; they hear mysteriously, but so friendly and loving is the voice that they are not afraid. It says: *Sila ersinarsinivdlugo*, "danger threatens from the Universe." The children understand and tell it as if accidentally when they come home, without having any idea of its serious meaning. Then the conjurors take measures to prevent the impending catastrophe.

During good times Slam-jua has no message for man. He has disappeared in unending Nothing and stays away as long as man does not misuse the game, i.e. waste food or throw it in places which are not worthy of the holy meat. Slam-jua is never seen, and his habitation is mysterious. At the same time that he is with us he is also unendingly far away.

[16] K. Birket-Smith: Ethnography of the Egedesminde District, *Meddelelser om Grønland*, Vol. 66. 1924.

FIG. 5

FIG. 6

FIGS. 5 and 6—In spring the expedition lived in tents, but in winter they built snow huts. Figure 5 is on Melville Peninsula. Figure 6 is not far from Baillie Island east of the Mackenzie delta; in the background high rough ice.

The mediators between the Universe and the mysterious forces of life are of course Angakut, the conjurors. I have a great deal of material regarding them and their functions, a splendid source of information for understanding the Eskimo psychology. I will merely touch on it here.

The Making of a Conjuror

It rarely happens that a person becomes a conjuror by his own choice. It is Sila that comes to him (or her) making him her vehicle for the benefit of his fellow man. Though the main principle in all conjuring and the relation of the conjurors to the supernatural is the same among all Eskimos, there are extremely numerous variations in the method by which the spiritual connection is achieved.

I found the most primitive form of conjuring among the inland dwellers, the Caribou Eskimos. It is primitive because the greatest weight is placed on isolation and not on tricks with which to impress the audience. A conjuror by the name of Igjugarjuk gave me his confidence and told me many interesting things.

Through dreams Sila had made it clear that she had chosen him as her tool. He was at once apprenticed to an old conjuror. His first initiation was in the middle of the winter, during the sharpest cold, when he stayed for thirty days in a small, unheated snow hut, without light, without sleeping skins, just sitting on a little piece of reindeer skin. He fasted during all this time: with days' intermission, there was brought to him through a hole in the snow hut a drink of heated water and just enough food so he would not starve to death. During these thirty days of isolation, enduring intense suffering, he came into touch with his first helping spirits, partly through dreams and partly through fever visions. When the time was up his teacher came with a sled which only he, and not the dogs might pull. Igjugarjuk was then so exhausted that he had to be carried over to it. This training was repeated at intervals until the old teacher deemed the time arrived for the apprentice to commence practice among his comrades.

The conjuror does not stay in the house or tent where the congregation is assembled; he must go out in the open, be out in touch with Sila constantly, in all sorts of weather, fasting for days and steadfastly thinking of the problem before him until he receives an answer from Sila through his helping spirits and can turn back to the snow hut again. Igjugarjuk described his art in the following words:

"The true wisdom is only found far away from people, out in the great loneliness, and can only be reached through suffering. Hardship and suffering are the only things which can open the mind of man to that which is hidden from others."

Another conjuror, a coast Eskimo from Iglulik told me the following:

When a young man (or girl) has become aware, through dreams or warnings, that the spirits wish to get in touch with him he gives part of his

FIG. 7

FIG. 8

FIG. 7—Typical tent of caribou skin, Barren Grounds.
FIG. 8—Difficult navigation. Returning from the Barren Grounds to the headquarters of the expedition on Danish Island.

property to a conjuror. Thus when he himself was apprenticed, he had given the conjuror a tent pole to which was tied the wing of a sea gull, as a symbol of the fact that he was to rush through the air to the land of the dead or dive down to the domain of the sea animals. The gift to the conjuror thereafter is set up outside a tent or a house as a present to the helping spirits, and in the evening the conjuror holds an exorcism in the presence of the apprentice and his parents. But first they have to be cleansed: that is, confess breaking of the taboo and all their sins in the presence of the settlement. After this the apprentice is mature enough to follow the customary ritual.

The method by which they enter into possession of their helping spirits shows great imagination. For instance, a ball of fire rushes through the air and enters the body. Every real conjuror has an Angatkua or a Gaumaneq—something which lights up his body, head or brain, an illuminating fire—which not only makes it easy for the spirits to know him but also enables him to see in the dark, literally and metaphorically. He is then in a position to discern hidden things, to look into the future, to read the secrets of others, and in the moment when the spirits are animate in him he feels so great a joy that he must burst into song—a special song which the spirits have taught him.

Many remarkable details were learned from the conjurors all through the Northwest Passage, but on the whole they are similar to the instances described. It is in Alaska only that the East Greenlandic tricks which we know so well from the vivid descriptions of Commander Holms are practiced to any great degree. Here also training takes place in isolation, but sometimes proofs of supernatural powers must be given: for instance, by hanging oneself in the presence of the entire settlement or by letting oneself burn alive. This purifies and cleanses the conjuror so that he becomes strong in his art. I have heard of several cases where the conjuror himself was so sure of his supernatural powers that these demonstrations resulted in death. This fact answers the question as to the genuineness of the conjuror's art. Many are conscious fakers, but there are others who take it in profound earnest.

Importance of the Amulet

That which has already been said regarding the basis of the religion of the Eskimos shows, first of all, that the unintelligible, mysterious powers which maintain the contact between the supernatural and man are dangerous powers to a predominant degree. The conjuror, in spite of all the mysticism with which he surrounds himself, is ultimately only a human being; and the mind of the primitive man demands something more incomprehensible, more fantastic, than anything which can come from a man who at other times lives as an ordinary person. This would appear to be the psychological reason for the great importance of amulets in man's battle against his unseen enemies.

The innumerable taboo regulations must also be noted in this connection. These are especially directed towards women on account of the religious uncleanliness which the Eskimos connect with childbirth and menstruation. Then there is the mysterious force, especially as a shield against illness, which lies in the name. I can instance cases among the Netsiliks of King William Land where a man or woman has from 17 to 20 names. There are also the various magic songs which can be used either as a sort of morning prayer or as a magic communication to hunted game, or otherwise to abolish taboo in such cases where it cannot be carried out for practical reasons. We must here confine ourselves entirely to the question of the amulet. Its importance and comprehensiveness may be gleaned from a simple observation: I have seen a seven-year-old boy wearing not less than 80 of them! A few examples will serve to show the type of material included in our collection of about 300 amulets.

FIG. 9—Holy stone to which the Eskimos offer sacrifices. Sentry Island.

An amulet belt for a man, to be worn outside the fur coat, consists of the nose of a seal and a harpoon point, which bring luck in sealing, and two Tornaq (spirit) whips, with which he lashes in the direction of a pursuing spirit.

Girls as a rule do not carry amulets on their own behalf, except such as ensure that they will become good sewers. An amulet worn by Tugaq, a little girl, for the son she hopes to bear, was comprised of the beak of a swan (the child will be a boy), the claws of an owl (for strong nerves and forcefulness), a grouse (for a rapid and enduring runner), the skin of a sea gull (for luck as a salmon fisher), ermine (strength, dexterity, and endurance), the head, claws, and stomach of a raven (will bring his hunting comrades luck so that he will partake in many hunting parties, for the raven characteristically appears when the booty is put down), the teeth of a bear (the symbol of a hearty eater, gives a fat son).

The sexual organs of a female bear sewed into the back of the trousers has the symbolic meaning that the young man will always stand in the way of the bear and become a great hunter of bears. A thick branch is a sign of growing power; the head of a wolverine means strength; spiders, with which the skin between the fingers is stroked once in a while, make for ability in all handicraft. The hair of a wolverine sewed into a fur collar is especially popular among young men because it makes the beard grow.

Incidentally it may be remarked that every amulet has its special place without which it has no value.

For further interpretation of the significance of the amulet I will take the expositions of two conjurors: one from Iglulik, northeast of Melville Peninsula, the other from Nunivak Island, these places representing extremes of the territory through which we traveled.

The conjuror Aua from Iglulik near Baffin Land described his interpretation of amulets in the following way: "It is not the amulet itself but the soul of the animal from which the amulet is taken which has the helpful, active power. It is, however, not immaterial which part of the animal is taken—it must be certain specific parts." The amulet acts magically, and its power therefore is not bound absolutely to the person who carries it. It can be given away but in such a way that its magical power can only be transferred to its new owner if he presents the giver with great gifts. If he does not do so, the power of the amulet remains with the original owner. For this reason one may keep the magical power even though the amulet itself is lost.

It is also usual to receive an amulet from an old man who has been a good hunter in his time. At Iglulik sleeve bands were bought from a famous old caribou hunter for a boy whose father had always been very unlucky, in fact had never succeeded in bringing down a caribou. The boy had the bands sewed on his sleeves every time he got new clothes, and in contrast to his father, and by the strength of this amulet, he became a very good hunter.

The man from Nunivak, who by the way is the one cited when speaking of Sila, expressed himself as follows:

"The people of a settlement should always have as many different amulets as possible because this gives individual strength. Only the special amulet can do anything special for its owner. If all carry the same amulet, the strength will be split and the men will be poor hunters. A man and a woman with the same amulet may not marry."

In many talks with the Eskimos I always began with the question of whether it was the object itself or its spirit which owned the magical force. For instance, in the case of the claw of the owl; is it the claw which helps the bearer, as a lucky shilling might help, no matter who carries it, or is it the spirit of the owl in a certain mysterious relation to the owner? The answer was everywhere the same: "It is the spirit which helps. The claw is only a symbol."

Hitherto it has been the belief that a regular totemism was practiced among the Eskimos in southern Alaska but that this was entirely foreign to all other Eskimos. In contrast we found continuity in the trend of Eskimo thought and beliefs. A real totemism with clan divisions is not found anywhere among them. The so-called totem marks on the tools of the Alaskan Eskimos are only identification marks to aid recognition, even though they receive something of the character of an amulet by descending

from father to son. On the other hand, the mystical relation between the amulet and its owner, which is found among all the tribes, shows that the Eskimo belief contains the germ of totemism, and the Alaskan Eskimos have undoubtedly progressed further because men and women with the same amulet may not marry.

In passing I shall now remark on the high degree to which religious ceremonial has developed among all the Eskimo tribes.

With the Caribou Eskimos all festivals center around luxurious feasting and singing. Among the Netsilik there is some development of athletic competitions, combined with the same feasts and singing. The festivals are elaborated more and more as one travels farther west, culminating in the Yukon District. This is probably connected with the fact that the Eskimos in southern Alaska have had intimate connections with the Thlingit Indians on the northwest coast of America and, I understand, especially on Nunivak Island. All the festivals are of a religious character. Many of them last for eight days with a constant display of fantastic and complicated ceremonial. Some of them are: the christening feast, the feast for the bladder of the seal, the trading feast, inaugural feast for the kayak, the feast for tying nets, the feast for the great spring hunt, the autumn feast, the big seal feast, and small seal feast, the inaugural feast for new settlements, and the feast for the dead. The last may only be held by the most prominent in the community and for it three years' preparation is involved, as the one who gives the feast must have the booty of at least three years of hunting to give as worthy presents to his guests.

I have enumerated these feasts in this connection because Sila is represented by over 100 different masks which take a direct part in the festivals, and because in several instances a particularly solemn dedication of amulets takes place.

PHYSICAL ANTHROPOLOGY, LINGUISTICS, AND MATERIAL CULTURE

By Kaj Birket-Smith

The tribes studied in detail by the Fifth Thule Expedition were those occupying the regions west and northwest of Hudson Bay. Linguistically and culturally they may be divided into three different groups.

Tribal Divisions: Northern, Western, and Central Groups

The northernmost of the tribes comprises the Tununermiut (people of the place farthest back) of Ponds Inlet, the Iglulingmiut (people of the house place) of Fury and Hecla Strait and the east coast of Melville Peninsula, and the Aivilingmiut (people of the walrus place), living at

Repulse Bay and the western shore of Rowe's Welcome. Since the aboriginal population of Southampton Island, the Sadlermiut (people of the place in front), became extinct in 1902, the Aivilingmiut have taken possession of the entire island. The total number of the whole group is small, being only 507 persons according to the census taken by Therkel Mathiassen. These tribes, at any rate the Tununermiut and Aivilingmiut, are most influenced by white men.

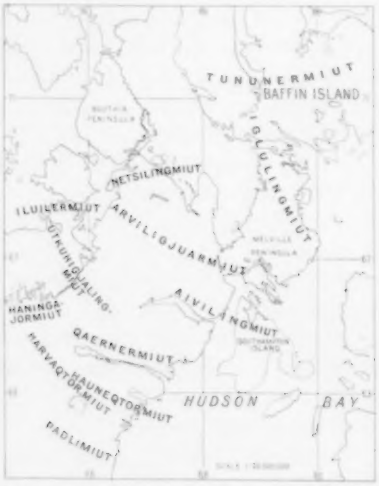


FIG. 10—Sketch map showing the Eskimo tribes west and north of Hudson Bay that were studied in detail by the Fifth Thule Expedition. From Kaj Birket-Smith's map on p. 193 of the *Geografisk Tidskrift*, Vol. 27, 1924.

The western group is generally spoken of by the other Eskimos as Netsilingmiut, but in reality it comprises several tribes besides the one that can justly claim this name. The natives of Simpson Peninsula are known as Arviligjuarmiut (people of the big right whale place). It is a rather considerable tribe, several members of which have emigrated to the Repulse Bay district and settled among the Aivilingmiut. On the other hand, the Sinimiut of Rae and Hall are now practically extinct, there being only two survivors who live near Wager Inlet. The Netsilingmiut proper (people of the fiord seal place) live on Boothia Peninsula and King William Land, the Utkuhigjalingmiut (people of the soapstone place) at the mouth of Back River, and the Haningajormiut (people of the place athwart), or Ualiardlit (the southwesterners), at Lake Garry. The tribe of Simpson Strait is generally known to the ethnologists as the Ugjulingmiut (people of the bearded seal place). This name, however, is not the proper one; they themselves always use the term Iluilermiut (people of the island-like land). Finally Rasmussen discovered a new tribe, or rather a sub-tribe of the Netsilingmiut, viz. the Arveqtormiut (people of the right whale-abounding place) living as far north as Bellot Strait. The western group is the most populous of the three, the number, according to the Rasmussen census, averaging about 600. It is also less influenced by the whites than any other group, in fact probably less than any other tribe of the whole Eskimo stock.

The southernmost group comprises the interesting inland tribes, which, owing to the vital part the caribou play in their lives, we have thought of naming the "Caribou Eskimos," corresponding to the appellation of Copper Eskimos for the natives of Coronation Gulf and Bathurst Inlet. The best known representatives of this group were formerly called "Kinipetu." This name, however, should be deleted from scientific terminology, as it

belongs to the whalers' jargon and is meaningless. The Eskimos never use it, hardly even know it, but call themselves Qaernermiut (people of the flats). This word is mentioned for the first time by Boas as "Kiaknukmiut" and later in another form (Kournoomiut) by the same author, who, however, in that case took it for a name of the Back River Eskimos.[17] More recently Stefansson[18] and Jenness[19] heard it at Coronation Gulf, but likewise thought that it applied to the Back River natives. In reality it is the true appellation of the "Kinipetu."

The Qaernermiut live inland round Baker Lake and Chesterfield Inlet. Formerly, when the whalers visited the coast, some members of the tribe used to winter round the ships at Marble Island and Fullerton, but since the whaling stopped, only two or three families winter on the coast. South of the Qaernermiut, on the lower Kazan River, live the hitherto unknown Harvaqtormiut (people of the rapid-abounding place), and southwest of Rankin Inlet the Hauneqtormiut (people of the bone-abounding place). The first tribe is entirely an inland one and never visits the coast at all, but the second comes annually to the coast late in the spring. South of these tribes again live the Padlimiut (willow people) round Hikoligjuaq and the upper Kazan River and farther east. The western band of this tribe never comes to the coast at all, while the eastern group pays an annual spring visit to the sea just as the Hauneqtormiut do. The total number of Caribou Eskimos amounts to about 500 persons,[20] but during late years they have decreased rapidly owing to terrible famines when the caribou hunting failed. The Padlimiut tribe alone is about as numerous as the other three put together. Although these tribes have been able to procure European goods from Churchill for 200 years, they are less influenced by white men than the Aivilingmiut, who have only been in contact with the whalers for about 60 years. Most of the women and children of the inland tribes had never seen a white man.

Physical Anthropology

Observations on physical anthropology are difficult to obtain in the Arctic. The population is so sparse that the number of persons measured must always be very limited, and furthermore measurements taken in a tent or a snow hut cannot lay claim to the same exactness as those made in a comfortable laboratory. Nevertheless the writer had the opportunity of measuring 112 persons of different tribes, viz. 15 of the Iglulik group, 35 Netsilik Eskimos, and 62 Caribou Eskimos. All of them are men and, with a few exceptions, more than 20 years old. Our collections comprise 3 whole skeletons and about 40 skulls, most of them from Naujan in Repulse Bay,

[17] Boas, The Eskimo of Baffin Land and Hudson Bay, p. 480.
[18] First work cited in footnote 12, pp. 28, 290, 302.
[19] Work cited in footnote 12, p. 49 footnote.
[20] Some Padlimiut, of whom we could obtain no exact information, live on the Kazan River south of Hikoligjuaq.

but some from Ponds Inlet, 2 from Southampton Island, and 1 from Eskimo Point. In addition we have several samples of the hair of living persons.

The measurements of 99 men, more than 20 years of age, show an average height of 160.6 cm., a standard deviation of ± 6.0 cm., and a mean error of 0.6 cm.[21] The observations do not group themselves quite symmetrically round the mean, but on the other hand the material is too small to permit of any further conclusions. In other words these Eskimos are below medium height, but do not belong to the really small races and compare favorably with the Japanese and several Siberian tribes. A comparison with other Eskimo tribes is given in the accompanying table.

TABLE I—COMPARISON OF STATURE AND CEPHALIC MEASUREMENTS

LOCALITY	STATURE (CM.)	CEPHALIC MEASUREMENTS (MM.)	
		LENGTH	BREADTH
Hudson Bay	160.6	193.7	149.7
Point Barrow	161.5		
West Greenland	162.0	192.1	148.5
East Greenland	162.9	192.0	147.0
Coronation Gulf	164.8	195.9	151.8

From this it will appear that the population at Hudson Bay shows the smallest stature of all tribes from which we have material of any importance.

Turning to the cephalic measurements we find the average length of the skull to be 193.7 mm., standard deviation ± 5.9 mm., and mean error 0.6 mm.; average breadth 149.7 mm., standard deviation ± 4.7 mm., and mean error 0.5 mm. A comparison with other tribes is given in Table I.

Hence the dimensions are between the Greenland measurements on one side and the Coronation Gulf measurements on the other, the figures being a little higher than the former and somewhat lower than the latter. The cephalic index is about the same, and these natives must be characterized as a mesocephalic people. In facial measurement also the average is a little below that of the natives of Coronation Gulf, but it is certainly typically Eskimo.

LINGUISTICS

Originally linguistic work was not included in the plans of the Expedition. So extremely scarce, however, is linguistic material from the Central Eskimos it seemed worth while to attempt a collection, although the author is not an expert. He has compiled a comparative, phonetic vocabulary of 500 words from three dialects representing the three main groups of tribes, viz. the Iglulingmiut, the Arviligjuarmiut, and the Padlimiut.[22] To these were

[21] These and the following calculations I owe to my cousin, Dr. J. F. Steffensen, professor of mathematics at the University of Copenhagen, for whose assistance I wish to express my thanks.

[22] Dr. Rasmussen collected similar vocabularies, in the orthography of Kleinschmidt with a few modifications, from the principal dialects between Back River and Nunivak Island in Bering Sea.

added a similar list from the Polar Eskimos and another from the middle part of West Greenland. The vocabularies of the Greenland and Central dialects are very similar. There is, I think, not more difference between West Greenlandic and Netsilik than between English and Scotch, and from the very first meeting both Knud Rasmussen and our own natives conversed

FIG. 11

FIG. 12

FIGS. 11 and 12—Typical woman and young man from the Barren Grounds.

quite freely with the local population. Phonetically, however, there are certain facts of very great interest.

Twenty years ago Thalbitzer proved the existence of a consonant metathesis in the Eskimo dialects.[23] The more primitive forms we have in Alaska, but in southern Baffin Land and Labrador a retrogressive uvularization has taken place. At Smith Sound and in West Greenland we find the same uvularization and in addition a retrogressive labialization.

From a linguistic point of view, there is no such group as the Central Eskimos, though it is a convenient geographical term. The eastern division of the Eskimo dialects may be said to comprise three groups:

1. The Greenland dialects with fully developed metathesis.
2. The Labrador-Baffin Land group, extending as far as Chesterfield Inlet on the west coast of Hudson Bay. Here a retrogressive uvularization has taken place, but no labialization.

[23] William Thalbitzer: A Phonetical Study of the Eskimo Language, *Meddelelser om Grønland*, Vol. 31, 1904.

3. The dialects of the Barren Grounds and the regions round the Magnetic Pole with no metathesis, in this respect related to the Alaskan dialects.

Sometimes the hypothesis is advanced that Alaska is the cradle of the Eskimos on account of the primitive dialects there. It must be emphasized that according to our investigations the most important primitive features of the phonetics extend right to Hudson Bay.

FIG. 13.—Woman gathering fuel, Barren Grounds.

MATERIAL CULTURE: THE CARIBOU ESKIMOS

While the Iglulik and most of the Netsilik tribes live much as other Eskimos, catching seal in winter, deer hunting and trout fishing during the summer, the life of the Caribou tribe is quite different. About two-thirds of this group, i.e. all the Harvaqtormiut, nearly all the Qaernermiut, and more than half of the Padlimiut, never visit the coast at all, and there are grown-up men who have never seen a seal. On one occasion, for instance, they questioned us as to where the horns of the seal were placed, and they forbade us to cut up the walrus meat we were carrying as it was entirely unknown to them. Their main occupation the year round is caribou hunting. The autumn hunt is the most important, for then the deer are fat and the skins fit for clothing. In summer and winter, when caribou hunting is less profitable, the Eskimos fish for trout, whitefish (*Coregonus*), pike, etc. Caribou hunting, however, is the foundation of economic life, and in the early spring, when the cached meat from the autumn has been consumed and the caribou have not arrived yet from the woodland in the south, there are annual periods of starvation, and as a rule several persons succumb to hunger. During the winter these tribes live in snow huts, in the summer they use conical deerskin tents. The only means of conveyance are dog sledges of primitive shape, long and narrow, as the kayak is only used in hunting, and the umiak (women's boat) is entirely unknown. During the summer the sledge dogs are used as beasts of burden.

The remaining third of the Caribou Eskimos live in the same manner, except that they generally come to the coast about the beginning of June

and stay there a couple of months. Here they hunt seal and walrus in wooden canoes, bought at the Hudson's Bay Company's store. Formerly kayaks were used, but these have now disappeared from the whole coast. On the other hand they never hunted whales, not even white whale or narwhal.

The inland character of their civilization is markedly reflected in their religion, which is quite different from that of the coast dwellers. Although

FIG. 14

FIG. 15

FIG. 14—Man from Pelly Bay. His parents had met with members of the Franklin Expedition.
FIG. 15—Umingmagtormiut woman from east of Bathurst Inlet.

they have many traditions similar to those of the Greenlanders, the moon plays no part in their religion. The influence of the moon on the tides, with which the Eskimos on the coast are well acquainted, has no significance here.

ORIGIN OF THE CULTURE

Which of the two cultural types is the older one? Eskimo traditions, ethnographical and archeological facts all agree. The Eskimos say that they all used to live inland but that some of them, pressed by the Chipewyans, began visiting the coast. Even in the present coast culture there are survivals from an early inland period; the coast kayak was often covered with deerskin, and, while the Hauneqtormiut use the blubber lamp to a limited degree, the Padlimiut always build heath fires even on the shore and never use blubber for fuel. In spring at the height of the sealing season, when blubber in superabundance was found everywhere in the camp at Eskimo Point, I have seen the women walk for miles inland to gather fuel on the snow-free hilltops. Therkel Mathiassen shows in his archeological

report that a cultural state different from the present one once prevailed along the coast.

We have traced the present coast population back to the inland. Now the question arises: Did the ancestors of the inland population never at some remote period live by the sea? Is it not possible that they are descended from the ancient coast dwellers, adapting their mode of living to inland conditions, possibly under Indian influence? As a matter of fact, some slight Indian influence can be detected among most Central Eskimos; Boas has, for example, called attention to the tobacco pipe and a few myths,[24] and it is only natural that the Caribou Eskimos should be more influenced than the remoter tribes. Cultural elements of Indian origin among the Padlimiut are snowshoes, the flute, the smoking of meat, skin coloring with ocher, and double-curve ornamentation. The style of the last goes to show an influence that is not quite modern, for among those Indian tribes that are in touch with the Padlimiut (i.e. the Chipewyan and Cree) the pure double-curve ornamentation was long ago obscured by European floral designs. On the other hand none of the Indian elements has really been absorbed by the Eskimo culture, they always appear more or less casually. There are other Indian elements which might very well have been adopted by the Eskimos, but which are nevertheless lacking.

We meet with great difficulties, if we try to explain the inland culture as an offshoot from the coast. It is true that for purely geographical reasons some coast elements would be bound to disappear in the interior, but why should an inland population cease to use bola and bird hook, fishing net, adze, the "winged" needlecase, etc., which can be manufactured inland as well as at the coast? And why should they cease to procure blubber from the coast? It is hard to imagine a tribe that once used the blubber lamp moving inland and spending the winter there at a temperature sometimes as low as − 50° C. in entirely unheated snow huts without trying to improve their circumstances.

There are Eskimo inland tribes at Colville River in Alaska. They, however, seem to depend more or less on the coast population, buying blubber for fuel, sealskin thongs, and walrus skins for umiak coverings. On the Barren Grounds it is quite different. The Eskimos here always use heath for fuel, and deerskin boat coverings, and, though they may occasionally buy a few lengths of sealskin thong from the coast, their principal lashings are made of babiche.

The Most Primitive Eskimo Culture

Consequently the writer is at the present time inclined to consider the culture of the Caribou Eskimos the most primitive Eskimo culture known, perhaps a survival of a Proto-Eskimo culture from the time when the transition to coastal life had not yet taken place. It is not believed, however,

[24] Boas, The Eskimo of Baffin Land and Hudson Bay, pp. 365 *et seq.*

that this transition occurred on the shores of Hudson Bay. It must be remembered that the migrations of the caribou are here parallel to the coast and could hardly be supposed to take an original inland population to the sea. Moreover, the topography of the shores of the bay would not invite a tribe to transform its culture; the shallow waters make hunting on the ice rather difficult. Finally the excavations about Hudson Bay show a fully developed coast culture.

FIG. 16—Archers from the neighborhood of the north magnetic pole.

A hypothesis regarding the development of Eskimo culture may be tentatively stated thus:

First of all there was a culture connected with the inland waters.[25] Probably, as supposed by Steensby, it was adapted to the sea ice and formed a Paleo-Eskimo culture. This adaptation probably took place between Coronation Gulf and Boothia Peninsula, where the migrating caribou would take the population to the coast. But the extensive Barren Grounds west of Hudson Bay retained the group which we have called the Caribou Eskimos, thus preserving a stage which might be called Proto-Eskimo.

Afterwards Steensby's Neo-Eskimo stage developed at Bering Strait and spread in an easterly direction.

Finally a fresh advance of comparatively recent date came from the interior and largely obliterated the Neo-Eskimo character of the coast culture.

[25] Cf. the author's treatise "A Geographic Study of the Early History of the Algonquian Indians," *Internatl. Archiv. für Ethnogr.*, Vol. 24, Leiden, 1918, pp. 174–222; reference on pp. 215 *et seq.*

I believe that this development fully agrees with the archeological results of Mathiassen, and they are also in harmony with the view of Jenness, who supposes the arrival of the Copper Eskimos at the coast to be a rather late event.[26]

THE ARCHEOLOGY OF THE CENTRAL ESKIMOS

By Therkel Mathiassen

Extensive excavations were made by the writer in the country of the Central Eskimos, the chief sites being near Repulse Bay, Ponds Inlet, and on Southampton Island (see Plate IV).[27] The investigations have a particular interest inasmuch as they represent the first systematic work in the region. On the basis of more or less accidental finds Boas and Thalbitzer had been able to show a noticeable likeness between prehistoric objects from Greenland and finds from Southampton Island and adjacent areas. It was hoped that a thoroughgoing investigation would throw much light on the problem of Eskimo migrations.

In Repulse Bay the work was carried out during two months of the summer of 1922 at Naujan, a locality on the northern shore, briefly mentioned by Hall. Here, on a grassy slope, were found the remains of a large settlement consisting of 20 ruins of winter houses, surrounded by numerous meat caches, graves, and other material. Ten of the house ruins and 60 square meters of an extensive refuse heap, about 1 meter deep, formed before the doorways of three of the houses, were excavated. About 2500 archeological specimens, besides numerous bones of animals, pieces of wood, and other refuse were found. Fifty graves were investigated; and several skeletons, some 20 skulls, and 50 specimens of artefacts were found.

It is a striking fact that the settlement is situated at an elevation of from 12 to 20 meters above the sea and at a distance of 100–150 meters from the shore line; from some of the houses it is not even possible to see the sea. An Eskimo would hardly build his house in such a place, the more so because conditions for building are good near the shore: why should he transport the whale skulls and other heavy building materials, and later on his catch about 10 meters higher than need be? The circumstances suggest that since these houses were built the land has risen 8–10 meters, in the case of the highest (and oldest) houses possibly 13 meters. The many raised beaches also indicate a rapid rise of the land.

[26] Diamond Jenness: Origin of the Copper Eskimos and Their Copper Culture, *Geogr. Rev.*, Vol. 13, 1923, pp. 540–551.

See also Jenness' paper "A New Eskimo Culture in Hudson Bay," in the July number of the *Geogr. Rev.*—Edit. Note.

[27] Other investigations were made by Freuchen at Chesterfield Inlet, by Birket-Smith at Sentry Island, south of Ranken Inlet, by Rangsted at Vansittart Island, and by Rasmussen on King William Land and Point Hope.

The houses are of the whalebone type,[28] i.e. they are circular, 4 to 5 meters in diameter, half underground. The walls are built of stones, turf, and whale skulls; the roof of whale jawbones and ribs and turf. The back part of the house is occupied by a raised platform covered with flat stones and heath. In some cases two or three houses are connected by a common doorway. The ruins are so old, disintegrated, and overgrown that it was

FIG. 17—House ruin, Southampton Island. Length of spade 1 meter.

impossible to recognize the arrangement in the interior. Moreover, some of the best preserved houses had been despoiled by Eskimos the preceding summer.

The material of the implements and artefacts includes whalebone, ivory, antler, baleen, a little musk-ox horn, slate, green jade, flint, soapstone, a little wood, a few pieces of native copper, and one piece of meteoric iron fitted as a blade into a harpoon head. There are no glass beads or other signs of communication with white men. The objects made of baleen were especially numerous; the lower layers of the refuse heap being very rich in implements of this material, weapon points, knives, bows, arrows, cups, pieces of plaiting, and nets and knots of different kinds.

At Aivilik, another village site in Repulse Bay, one house ruin, standing high above the more recent summer settlement of the Aivilik Eskimos, was excavated and several of the Naujan types were found. Here a recent considerable rise of the land is even more evident. Numerous other house ruins are situated on the coast from south of Sentry Island to Iglulik. According to information obtained by Birket-Smith from the Eskimos,

[28] Whalebone here means the bones of whales; the "whalebone" of commerce is called baleen.

FIG. 18—Types of implements found at Repulse Bay (1–33) and in the Ponds Inlet region (34–42): 1, whaling harpoon head; 2 and 3, common types of harpoon heads; 4, slate blade for a harpoon or lance; 5, ivory foreshaft of lance; 6, a barbed point of baleen; 7, point of barbed harpoon; 8, ivory ice pick; 9, antler arrowhead; 10, bird harpoon; 11, foreshaft of a bird harpoon; 12, barb for salmon spear; 13, ivory salmon decoy; 14, loose foreshaft of harpoon; 15, whalebone ball for bird bola; 16, detachable lance head; 17, flint blade for knife (the best flint implement found); 18, skin scraper, shoulder blade of deer; 19, bow of baleen; 20, handle of woman's knife; 21, miniature *ulo* handle; 22, buckle for dog traces; 23 and 24, knife handles; 25, bone adze head; 26, miniature soapstone lamp; 27, bird, with human forepart, ivory, ornamented; 28, human figure, ivory; 29 and 30, ivory pendants; 31, slate pendants; 32, snow knife of whale rib; 33, blade of mattock of whale rib; 34, part of platform mattress of plaited baleen; 35, baleen cup, with wooden bottom; 36, small ivory cup; 37, mouthpiece of drill, astragalus of caribou; 38, wooden implement, suggesting miniature throwing board; 39, ornamented ivory bow for drill; 40, wooden seal scratcher; 41, slide prong of bird dart; 42, hook for catching gulls.

there are also ruins about one day's journey inland from Sentry Island. I have myself seen house ruins at ten different places between Repulse Bay and Iglulik all of which resemble the Naujan houses in respect of elevation above sea level.

A few scattered implements brought by the Eskimos show that the Naujan types occur all over the country; they also appear in Freuchen's find at Chesterfield Inlet, consisting of 35 specimens.[29]

In northern Baffin Land ruins of winter houses were found in several places, especially in the vicinity of Ponds Inlet. The elevation at which they stand appears to be less than farther south, most often it is about 8 meters but in one case 4–5 meters above sea level. But here too rise of the land since they were erected seems probable. At Ponds Inlet excavations were made during the summer of 1923 at the old settlements Qitalukan and Mitimatalik, both situated near the Hudson's Bay Company's post, and at Button Point on Bylot Island. About 1800 archeological specimens were obtained. Houses and types of implements were in general the same as at Naujan; other specimens found made a valuable supplement. In the summer of 1924, Freuchen carried on the excavations at Qitalukan and among other objects secured a spec-

[29] The collections from Vansittart Island made by Bangsted and numbering about 100 specimens have not yet arrived.

imen of the famous "winged" needlecase. For several reasons the writer is inclined to think that the finds from Ponds Inlet are a little more recent than the Naujan find, though belonging to the same stage of culture.

An interesting Eskimo tribe were the Sadlermiut of Southampton Island who were exterminated in 1902–1903 by disease brought by a whaling vessel. Our previous knowledge of these people was based on the collections secured by Captain Comer and described by Boas.[30] The writer was able to obtain additional information regarding their culture from two old Aivilik Eskimos who had lived and hunted with the Sadlermiut, and he secured also a good collection, found by Eskimos in the deserted villages.

An older stage of their culture is represented by the find of about 800 specimens made during the latter part of August 1922 at Kuk in Duke of York Bay. At this place are many house ruins, the largest group of which, numbering 14, is situated about three kilometers inland. The houses stand close to a salmon dam of the type always built at the mouth of a river; it is now 5 meters above sea level. The implements in the main show the same types as the Naujan find, supplemented by some special Southampton Island types, such as a lamp of cemented limestone slabs, fragments of limestone plates for cooking pots, fine specimens of flint including a knife 20 centimeters long, flint flakers, and sewing needles of ivory. Baleen was here less prominent on account of the poorer chances of preservation. No metal was found and very little wood.

The Kuk find is presumably a little more recent than the Naujan find but evidently closely related to it. The culture of the later Sadlermiut is derived from the old culture and is only slightly modified by local development and by influence from the Aivilik Eskimos.

The Thule Culture

The question now arises: What do these finds imply to the student of Eskimo culture? The territory of the Central Eskimos was in earlier times occupied by an Eskimo culture differing sharply from the culture of the recent tribes—the Aiviliks, Igluliks, Netsiliks, the tribes of the Barren Grounds and of Baffin Land—not only on account of the strong European influence, but as regards the nature of the implements. The old culture seems to have been mainly based on the hunt of sea mammals, especially whales, while the recent people are mainly caribou hunters. The old culture used winter houses of bones, stone, and turf; in the recent one snow houses are used in winter. Such types as square cooking pots, the skin comb, snow probe, wick trimmers of a special form, toggles for dog traces, large dippers of musk ox horn are unknown to the old culture; on the other hand it is distinguished by the bola, bird harpoon, oval cooking pots, pottery, seal scratcher, by a richly ornamental art, and by the use of baleen for almost every purpose. It is interesting to notice, that in the find at Anangiarsuk

[30] Boas, The Eskimo of Baffin Land and Hudson Bay.

of implements belonging to some Eskimos who starved to death about a hundred years ago there is nothing at all to suggest connection with the old culture.

This old culture has been named the Thule culture because the first examples were discovered by members of the Second Thule Expedition in "Comer's Midden" near the Thule station in the Cape York District of northern Greenland,[31] and its extension in the American continent and Arctic archipelago has been proved by the Fifth Thule Expedition. The Thule culture seems to have prevailed when the land was situated 10–13 meters lower than it now is and it was still predominant in Repulse Bay, when a stage had been reached some 5 meters below the present elevation. In northern Baffin Land it was possibly still later, or perhaps Baffin Land is rising more slowly than the mainland. In the north of Southampton Island remains from this culture occur down to 3–4 meters above sea level.

The Thule culture seems to have been superseded by the more recent culture represented by the Aivilik-Iglulik-Ponds Inlet Eskimos. There is some reason for the supposition that this later culture is derived from the interior, the Barren Grounds, where the inland tribes (Qaernermiut, Padlimiut) are still living. Only on Southampton Island, which is difficult of access, was the Thule culture able to persist in a slightly modified form. Whether it originated from actual migrations or only from cultural invasion it is as yet difficult to determine: there are facts supporting both hypotheses. The migration theory is supported by the old Aivilik tales concerning the Tunit, predecessors of the Aiviliks, a strong people who dwelt in earthen winter houses and caught whales and walruses; the men wore bearskin breeches and the women long boots (like the Sadlermiut and the Polar Eskimos); they went farther north when the Innuit (the recent Eskimos) came to the séashore and took possession of their land; the Sadlermiut were the last Tunit in the country. On the other hand some grave finds, especially from Ponds Inlet, seem to be transitional.

Some of the Thule people went to Greenland, where we traced them in "Comer's Midden." A later derivation of the same culture is represented by the finds in northeastern Greenland described by Thomsen, Ryder, and Thalbitzer.[32] In western Greenland most of the Naujan types are found scattered over the country; but the archeology is as yet too little known to allow of further conclusions. The culture of the Polar Eskimos is in many ways closely related to the old Thule culture.

Another branch of the Thule people went into southern Baffin Land and

[31] The part of it now in the American Museum of Natural History has been described by Clark Wissler: Archaeology of the Polar Eskimo, *Anthropol. Papers Amer. Museum of Nat. Hist.*, Vol. 22, 1918, Part III, pp. 105–166.

[32] Thomas Thomsen: Implements and Artefacts of the North East Greenlanders, *Meddelelser om Grønland*, Vol. 44, 1917, pp. 357–496.

C. Ryder: Om den tidligere eskimoiske Bebyggelse af Scoresby Sund: *Meddelelser om Grønland*, Vol. 17, 1895, pp. 281–343.

William Thalbitzer: Ethnological Description of the Amdrup Collection from East Greenland, *Meddelelser om Grønland*, Vol. 28, 1909, pp. 329–542.

Labrador, others spread over the Arctic Archipelago; their routes are always marked by the round, semi-subterranean winter houses.

Farther west similarity with the Thule culture was found by Jenness at Barter Island, west of the Mackenzie. The recent Alaskan culture, as we find it represented in its Arctic phase at Point Barrow, is in fact very closely related to the Thule culture when the comparatively recent Indian influence is eliminated. Of the many similarities between the Thule and Point Barrow cultures mention may be made of the whaling harpoon, seal scratcher, bird bola, baleen net, pottery, the rich ornamental art, the earthen semi-subterranean houses, and the importance of whaling. The Thule culture is much more closely related to the recent Point Barrow culture than to the recent Central Eskimo culture, and there is some reason for the theory that its home is to be found in Alaska.

It looks as if the Thule culture in a remote period existed in a highly homogeneous form from Alaska to Greenland. Expansion from the interior caused this culture to be superseded in the central regions by the culture represented by the recent Central Eskimos. But at the wings, Alaska and Greenland, particularly at Point Barrow and Smiths Sound, the old culture, though modified and further developed in different ways, still lived on. This result seems to agree very well with the similarities pointed out between Southampton Island and Greenland by Boas[33] and Thalbitzer,[34] and with the theory of Jenness[35] that the Copper Eskimos are an inland tribe, which in rather recent time migrated to the seacoast.

CONTRIBUTIONS TO THE PHYSICAL GEOGRAPHY OF THE REGION NORTH OF HUDSON BAY[36]

By Peter Freuchen and Therkel Mathiassen

Northern Baffin Land

In spite of the many expeditions which from time to time have touched its coasts northern Baffin Land has remained among the least known parts of the globe. In consequence it was taken as the main field for the geographic and cartographic work of the Fifth Thule Expedition in spite of the distance from the base, Danish Island.

In the spring of 1922 Freuchen journeyed from Iglulik along the northern shores of Fury and Hecla Strait to the unknown coast west of Cape Hallowell as far as Aggo Bay, and Mathiassen from Iglulik through

[33] Boas, The Eskimo of Baffin Land and Hudson Bay, p. 564.

[34] William Thalbitzer: Der ethnographische Zusammenhang der Eskimo Grönlands mit denen der Hudsonbai, *Baessler-Archiv*, Vol. 2, Leipzig, 1912, pp. 32–44.

[35] Diamond Jenness: *Geogr. Rev.*, Vol. 13, 1923, pp. 540–551; Vol. 15, 1925, pp. 428–437.

[36] See the map, Plate IV, facing p. 562. The names have been submitted to the Geographic Board of Canada and decisions are now pending. Iglulik in the text appears as Igdlulik on the map.

Gifford Inlet, to Admiralty Inlet, mapping the unknown southern half of this large fiord to about latitude 72° 40′ N. In the spring of 1923 Mathiassen took a route through Murray Maxwell Bay to the unknown Steensby Inlet and from here across country to Milne Inlet, the map of which was revised. In the spring of 1924 Freuchen took another route from Murray Maxwell Bay to Milne Inlet and thence to Ponds Inlet, through Eclipse Sound and Navy Board Inlet, along the southern coast of Lancaster Sound to Cape York and back, through the northern half of Admiralty Inlet, from Moffet Inlet across country to Milne Inlet, and again to Ponds Inlet. In addition to our own notes and surveys information obtained from the Eskimos has been used in the drawing of the maps, among others, that of the Anaularealing Fiord. It is on these foundations that the preliminary map (Pl. IV) has been prepared; but, as the material is as yet far from being completely worked up, reservation must be made for future corrections.

The Archean Terrain

Archean rocks compose the eastern half of our region, a large district to the southwest and a couple of smaller, isolated districts. The topography is varied; to the south, for instance, around Gifford Inlet is a rather monotonous, rolling plateau of 100 to 150 meters in height which drops quite steeply to coast and fiord. Eastward similar country extends to Murray Maxwell Bay. Northward the elevation declines to Admiralty Inlet, the southern part of which is low and rather rough. The rock in this southern section is a uniform, reddish gneiss with rather variable cleavage planes. Here and there, however, the monotonous formation is interrupted by elevated ridges, such as the "saw tooth" mica-schist mountains, in Moffet Inlet and a gabbro mass at Fury and Hecla Strait. The region is a natural continuation of the Archean plateau of Melville Peninsula and, like it, must be considered an old, slightly elevated peneplain, now dissected by ice and water. The summits rise as a rule to the same height, seldom over 200 meters, and as a rule are rounded.

East of Steensby Inlet we find a similar formation. A markedly steep ridge runs from north to southeast of the head of the fiord; it represents a fault-line scarp, forming the boundary between an eastern plateau about 300 to 400 meters high and a western section, low and somewhat rugged. From near the end of Milne Inlet a steep fault-line scarp forms the boundary of the elevated region of the primitive rock. Farthest west, around Milne Inlet and Arctic Sound, the land forms a plateau, 400 to 600 meters high, which drops steeply towards the deeply cut, ice-eroded fiords. To the north the land rises to the east coast, where the plateau is over 1000 meters in height and partly covered by an ice cap. The surface configuration is quite rounded except at the steep ragged borders.

We find even greater heights on Bylot Island, the south coast of which rises like a wall from Ponds Inlet to a height of 1200 to 1300 meters, and

farther inland heights up to 1700 meters have been measured. It is a great alpine land, largely covered by ice from which arise a number of sharply pointed nunataks. In the southeastern corner of the Island a low fore-

FIG. 19—Geological sketch map. For place names see Plate IV.

land fronts the rock wall, probably a beach formed by abrasion, now partly covered by morainic material. The constituent rocks are rather varied—gneiss, granite, mica schist with garnet, amphibolite, etc. Along the southeastern part of Bylot Island there is a broader foreland in front of the high land where the solid rock, at least to the west, is a coal-bearing Tertiary. Southwest of Albert Harbour the highland drops steeply to a low depression. In the river beds and cliffs the Tertiary sequence is ex-

posed, sandstone and clay, alternating with beds of coal; about fifty bags of coal for local use are taken out of the Salmon River Valley every year. Archean also outcrops from the glacial cover in several places in this area.

The Silurian Terrain

The western part of northern Baffin Land is covered by Cambro-Silurian deposits, which increase in thickness from southeast to northwest. Farthest south they form a continuation of the Silurian country of Melville Peninsula. Here the predominant landscape is a very low surface of loose limestone blocks which have been pushed up by the ice until they form regular dunelike ridges; where the land rises ridge after ridge is seen in sequence. When the solid rock appears at the surface, which is seldom, it forms a low flat plateau. Northeastward the surface rises. Between Ikeqtoq and Milne Inlet it consists of the remnants of a broad, comparatively low plateau, on the sides of which the steplike ledges of limestone are plainly exposed; but otherwise nearly everything is covered by loose blocks and beach and glacial deposits. On the boundary against the wall of primitive rock south of Milne Inlet is found a red sandstone with a pronounced dip to the south.

Farther north the rise in elevation continues; most of the country between Navy Board Inlet, Admiralty Inlet, and Prince Regent Inlet forms an extended, monotonous plateau 200 to 400 meters in height. Limestone dominates around the southern part of Admiralty Inlet. At times the rock is exclusively limestone, as in the tabular mountains, Tablerotit and Pusingnajojaq, a good 200 meters in height: at other times slate is intercalated, as at Yellow Valley. The limestone in general is a yellowish gray, quite hard and containing very few fossils (apparently Silurian). The roughness and sharpness of the surface is largely due to wind action.

In places the rock exhibits more variety, as at Giants Castle in Admiralty Inlet. This is a perpendicular wall, about 300 meters high, the lower two-thirds of which consists of an unfossiliferous whitish sandstone with a discordant parallel structure and a rusted surface. Above is a softer layer of sandstone and over this a great overhanging mass of grayish-yellow limestone and bluish-black slate. The entire surface has been carved by erosion into towers, buttresses, caves, and enormous caldrons. Canyons are cut deep in the high plateau, and the walls fall steeply to the fiords. In a river delta at Eqalulik in Admiralty Inlet there are a number of eruptive blocks, basalt and amygdaloid, which must derive from the back country, where later eruptions have covered the sedimentary layers.

The Pleistocene Glaciation

In the Glacial Period the country was entirely covered with ice. Large terminal moraines are numerous. South of the lake Angmalortoq, for instance, is a moraine 40 meters in height and 7 kilometers in length.

FIG. 20

FIG. 21

FIG. 20—Bylot Island from Eclipse Sound, showing the characteristic steep cliffs of the southern coast.
FIG. 21—Stone pillars, where kayaks are placed. Repulse Bay.

Striae are seen in several places; at the mouth of Gifford Inlet (from the north), on Cape Hallowell (from east-northeast), at Siming and Tablerotit (from the east), in Milne Inlet (from the south). They seem to show an ice movement out from the center of the country. The enormous fiords presumably have been formed by ice erosion, even though the valleys probably antedate the Glacial Period. The glaciers must have been deflected by the Bylot Island massif, and Ponds Inlet and Navy Board Inlet have been formed in this way; the steep walls and great depths at Ponds Inlet are probably due to the powerful erosion of the closely packed glacial masses. The high, pointed summits of Bylot Island have, however, probably always projected above the ice as they now do.

The ice is now confined to a comparatively modest area. The center of Bylot Island is covered by ice, and from this large glaciers push out toward the ocean. An ice cap covers the land east of Albert Harbour, and, according to the Eskimos, there is a larger ice cap back of Scott Inlet (longitude 71° W.). There are also small local glaciers at a few places, as north of Low Point at Oliver Sound and west of the lower end of Milne Inlet.

Since the Glacial Period the greater part of the country has been covered by the ocean; at Ponds Inlet there are well defined shore terraces up to a height of 200 meters and west of Milne Inlet up to a height of 400 meters. Beach deposits cover great areas, particularly in the lower country where they form flat plains; such as, for instance, the plain at Saputit. Here the river has cut clay banks, about 10 meters high, exposing a rich marine fauna. Delta deposits, which often afford the only habitable places in the regions of steep coasts, must also be named among the other postglacial formations.

Melville Peninsula

Melville Peninsula is surrounded on all sides by ice and is accordingly difficult of approach. Committee Bay to the west is always filled with old ice; Fury and Hecla Strait to the north is never open for ships; and the masses of ice which constantly block the coast to the east in Fox Channel and to the south in Frozen Strait make navigating so difficult that the accomplishment of Parry's expedition a hundred years ago must be considered as the height of nautical skill, combined with exceptionally favorable ice conditions.

What we know about the east of Melville Peninsula is due to Parry's descriptions of the coast as seen, however, only from the sea with the exception of the northeastern corner, near Iglulik, where he wintered. Dr. Rae, who traveled over Rae Isthmus and along the west coast in the year 1847, followed the ice along shore and did not go into the interior. Finally, Hall traveled from Repulse Bay to Iglulik and on to Cape Englefield, but his descriptions give practically no geographical information.

Our expedition has explored the southern part of Melville Peninsula

rather thoroughly. In addition Therkel Mathiassen and Peter Freuchen undertook a journey in 1922 to Iglulik, mapping the coast and parts of the interior. Additions and revisions were made by Mathiassen in 1923 and by Freuchen in 1924.

The bed rock of the greater part of the peninsula is Archean, chiefly gneiss. Only in a low, narrow belt in the eastern part do Paleozoic deposits (limestone) appear. The peninsula seems to have been entirely covered by ice. But subsequently the whole country was submerged and the glacial deposits removed in many places. Good examples, however, are seen to the south between Haviland and Gore Bays, especially near the former where a very large terminal moraine cut by the river stretches across the valley. Another was seen in the valley south of Barrow River, the shells found on it showing plainly that it had been submerged.

The expedition found striae at all points visited. At Repulse Bay they show a movement from the fiord down Welcome Strait; on Vansittart Island they point south 20° west, as well as due south and southeast in the southeastern part; along the east coast, where the striae are very plainly seen on the flat gneiss cliffs, they all point southeast.

For the most part the peninsula offers a landscape of monotonous plains of recent unconsolidated material from which project low gneissic knolls or a rather rugged gneissic topography. As a rule the plains are occupied by shallow lakes or marshes, often overgrown with rushes (*Carex*), willows, saxifrage, cassiope, dryas, and various kinds of grasses. The rivers have often cut down through the recent marine deposits showing layers of *Saxicava*, *Cardium*, *Mya truncata*, and other sea shells. The extent of these deposits has not been accurately determined. Strand-line features, at any rate, are found 170 meters above the ocean between Gore and Haviland Bays, but a positive upper limit of submergence cannot be given.

Uplift on the East Coast

At present the entire country is rising rapidly. This is plainly seen in the sequence of beach ridges that make up the entire east coast. There is a considerable difference between high and low tides; and, when there are eastern storms, the ice pushes material against the land, building these great ridges of pebbles and stones. Far out in Fox Channel one finds masses of drift ice carrying huge amounts of shore débris.

Occasional slabs of limestone are found among the boulders in the shore ridges near Vansittart and Danish Islands and also in Repulse Bay. These increase in amount as one travels north. From Usugarsuk in the south of Parry Bay the boundary with the Archean rock is more sharply marked; it withdraws farther back from the coast and may be followed as a line about 200 meters above sea level, running to the north. The shore thenceforward is composed of successive beach ridges rising inland in terrace formation. Usugarsuk itself is a gravel point pushed up by the sea ice; but in other places, as at Anangiarsuk, Amitsoq, and Ignertoq, peninsulas have

been formed in the progress of uplift by the tying of islands to the mainland. This is a phenomenon to be met with in greater or smaller degree all along the coasts here.

In order to make a short cut to the north in 1922, we drove through Hall Lake. This has so recently become a lake that the river to the south still bears the name Ikerasar, which means "sound," and the time can still be remembered when it was possible to sail with a shallow boat

FIG. 22—Reindeer at Point Barrow, Alaska.

round the eastern peninsula, at that time an island. The lake itself is very shallow with numerous gravel islands and ice-packed piles of stones along the shores. It lies outside the area of primitive rock, the border of which, 300 meters in elevation, is marked by a fault-line scarp. The surface of recent unconsolidated deposits is very low, eastward so low that one could hardly tell positively whether one was on the ocean ice or on land at a time when everything was covered with snow. The peninsula Pingerqalik is a broad marsh-covered plain of the usual limestone about 25 meters above sea level. The limestone here is more pronouncedly bluish gray in color and poor in fossils. Outside of Pingerqalik are a couple of small holms of ancient crystalline rock with basalt, exhibiting striae to the south and east.

Iglulik is a low, marshy island of broken limestone. The highest place on the island, west of Turton Bay, rises to about 35 meters elevation. The upper 10 meters consists of a massive limestone, bluish gray, hard and clinking, the beds vertical and as far as we could see unfossiliferous. Nerdlernarfok, a low island north of Iglulik, we did not visit.

North and West Coasts and Rae Isthmus

According to Dr. Rae's travel notes, it seems that a mountain ridge rises along the west coast of the peninsula. Thence, according to the Eskimos, the land drops slowly eastward to a depression that stretches in a general way northward from the head of Lyon Inlet. This depression, which

contains many large lakes, is often used as a road from Iglulik to Repulse Bay, via Haviland Bay. East of this we again meet the high, rugged gneiss country characteristic of the interior of the peninsula.

The northern coast toward Fury and Hecla Strait is a high and at times steep gneissic mountain ridge, back of which runs a valley paralleling the strait. Hall traveled to Cape Englefield along this valley as it affords a more comfortable route than the old, uneven ice of the sound.

FIG. 23—Eskimo boy hunting, northern Alaska.

Vansittart Island, Danish Island, and the islands between Gore Bay and Lyon Inlet are the tops of a drowned land, as is the peninsula between Richard's Bay and Hooper Inlet, in the north. The strong tide has kept the channels between the islands deep. Hurd Channel between the mainland and Vansittart Island in particular is remarkable for the raging current that always sweeps it free from ice. Gore Bay and Lyon Inlet possibly represent tectonic depressions in the primitive rock. According to the Eskimos, the latter is continued by a great lake and valley, all the way to Committee Bay. A depression is also said to exist from Ignertoq to Garry Bay. There is at least one other valley between these two; and, if the valley south of Fury and Hecla Strait and this strait itself are also considered as fractures, there is thus a system of parallel valleys traversing the country, an interesting feature but one which cannot be discussed here.

Melville Peninsula itself is attached to the mainland by Rae Isthmus. This was Rae's path to Committee Bay in 1846, and on the Fifth Thule Expedition it was used by Rasmussen and Bangsted on the way to and from the regions west of Melville Peninsula. The tongue of land is described as very low, with a few low gneissic islands, and everywhere covered by unconsolidated deposits. Rift valleys carrying rivers from lake to lake, lead from north to south. The lakes themselves constitute a large part of the tongue. It is said that a terrible wind, especially on the north side,

constantly sweeps the plains free from snow. The tongue has always been of importance to man, in part because it is the most comfortable way for him to travel from Committee Bay to Repulse Bay, but also because of the caribou migrations across this region in the spring and fall.

Life on the Peninsula

Melville Peninsula is known as a good hunting district. The greater number of the caribou pass through here on the way to Cockburnland and back, but in the interior there are caribou in summer as well as in winter. Wolves and wolverines follow in the tracks of the caribou, and there are many foxes and lemmings. The marmot, of which there are quite large colonies, has its northern limit in Fury and Hecla Strait. Bird life is scant except on the small islands off the coast. The low mountains do not afford good fowling cliffs, and, although the marshes would seem to be well suited for wading birds, the great numbers of ermine and foxes prevent hatching. The musk ox is no more to be found but has so lately disappeared that the Eskimos still know the names of men who have hunted it.

The ocean is rich in seals and walrus, and around the south coasts there are still not a few Greenland whales (*Balaena mysticetus*) to be seen; narwhals and white whales (*Delphinapterus leucas*) also appear in small numbers. The rivers are full of salmon trout, in many instances shut into the lakes by the rising of the land. Other fish do not seem to be of any economic importance to the inhabitants.

Driftwood is never found along the coast, and the plant life is of little direct use for the Eskimos. Some cassiope and willows that attain a height of about half a meter in sheltered places in the extreme south of the peninsula are used for firewood, and the branches are braided into mats to be used underneath the skins in the snow huts. A few berries ripen during the summer but are not always gathered.

Trading stations have been established at Repulse Bay by the Hudson's Bay Company where people foregather from the Netsilik as well as from the Aivilik and Iglulik tribes. This is really the country of the Aiviliks, but the strangers often stay a year in the neighborhood when they come to trade. The Iglulik tribe, which is scattered at intervals along the east coast all the way to Lyon Inlet, also take trading trips to Ponds Inlet.

Southampton Island[37]

Southampton Island is another land hard to approach. From the low limestone coasts of the south and west dangerous reefs stretch far out to sea; the steep northern coast is practically always blocked by drift ice from Fox Channel. Only Duke of York and South Bays offer a suitable approach. Button, Bylot and Baffin, Fox, Middleton, Parry, Lyon, and Low

[37] By Therkel Mathiassen.

have made contributions to the delineation of the island; but the first to give a substantially correct view of the island as a whole was the whaler Captain G. Comer in a map published by the American Geographical Society.[38] A later map by Captain H. T. Munn[38] in the *Geographical Journal*[39] adds nothing of importance; and a number of new points shown, especially in the interior, are incorrect. The writer went to Southampton Island in August, 1922, with the intention of remaining there for archeological work for two or three weeks; but drift ice prevented return until the following February. During this half year my Greenlandic interpreter, Jacob Olsen, and I moved about with the Eskimos, living as they did. During the summer we occupied the west coast of Duke of York Bay and visited the northern end of Southampton Island and White Island; in the fall we moved across country to the lower Kirchhoffer River, staying there during the winter. From thence I took a trip to South Bay. The return was made via the Kirchhoffer River and along the coast east of Cape Bylot.

Two Different Terrains

Southampton Island, like Melville Peninsula, includes two different terrains—Archean and Silurian. The primitive rock appears for the most part as a plateau, highest along the coast to the northeast, declining to the southwest; probably it is a peneplain uplifted and tilted. I have measured heights of over 400 meters on the watershed between the Kirchhoffer and Canon Rivers. The Porsild Mountains undoubtedly reach a height of 500 meters; which height is also said to be attained by Mt. Minto on Bell Peninsula. Along the eastern coast of White Island are heights of about 300 meters. To the west the borders of the plateau are somewhat lower, as for instance along the Cleveland River, where they are about 200 meters; at South Bay it is very low. The interior of this terrain is a uniform, high plain covered, for the most part, by loose glacial and marine deposits. From Duke of York Bay to Boas River there is a steep descent to the limestone country: the west side of Duke of York Bay is also formed by a rather steep cliff 200 meters high. On the east the plateau, cut by deep ravines, descends abruptly to the sea. Canon River drops over 300 meters in its course of about 20 kilometers. The upper course is a constant series of falls, often through deep ravines with vertical walls; farther down it flows more smoothly through a deeply cut valley.

The limestone terrain is flat and uniform. West of Duke of York Bay, heights of 38 meters altitude have been measured; the interior is a little higher, but the upgrade is as a rule scarcely noticeable. Around Hansine Lake, however, there is a steplike ascent. Where the bed rock can be seen it consists of a hard, clinking limestone, horizontally bedded

[38] George Comer: A Geographical Description of Southampton Island and Notes upon the Eskimo, *Bull. Amer. Geogr. Soc.*, Vol. 42, 1910, pp. 84–90, with a map on scale 1:2,150,000. See also "Additions to Captain Comer's Map of Southampton Island," *ibid.*, Vol. 45, 1913, pp. 516–518.

[39] H. T. Munn: Southampton Island, *Geogr. Journ.*, Vol. 54, 1919, pp. 52–55.

in some places, as at Kuk, where it is rich in Silurian fossils. Frost action has broken up the limestone into blocks later rearranged by ice and water. It is particularly the ocean that gives stamp to the country now. Especially near the coast the landscape resembles that of Iglulik, exhibiting a succession of beach ridges far inland. The ridges are very irregular in the interior, forming long, rolling elevations above the flat, barren, limestone plateaus, where the loose boulders are still very often in situ. The country around Cleveland River is a vast monotonous plain of limestone gravel, where the solid rock rarely appears. The configuration favors the development of lakes and ponds of all sizes. Around Kuk, for instance, they cover about a quarter of the area, around Cleveland River somewhat less. Wherever the naked limestone appears, either as a solid mass or in loose blocks, the surface is worn exceedingly rough and sharp-edged by the wind. In many places the flat pieces scaled off have been pressed down edgewise so that they cut like knives through the shoe soles. The waterways in the limestone section, as all the waterways on the island, are young. There is a constant succession of small lakes, rapids, and quieter stretches.

FIG. 24—The leader, Knud Rasmussen.

Southampton Island was covered by ice during the Glacial Period, as appears from the extensive morainic material. In two places at Kuk striae have been seen on the solid limestone, both running east-northeast. Now marine postglacial deposits cover most of the surface, in the limestone section as ridges of sharp-edged blocks or as finer gravel, mixed here and there with comminuted shells. At the mouth of Canon River the stream has cut through a layer of clay, containing shells, from 10 to 15 meters thick. Beach gravel has in one case been found 360 meters above the ocean and it covers wide areas on the high plains. It is certain that most of the island, maybe the whole of it, has been submerged since the Glacial Period.

A Good Game Country

The plant life of Southampton Island is very sparse; great areas in the limestone section, for instance around Hansine Lake, being an absolute desert. The great plains around Cleveland River are marshy in part and overgrown with grasses; along the river are willows from 30 to 40 meters high. The high plains have a sparse vegetation where cassiope, saxifrage, carex, luzula, and various grasses predominate.

Of the mammals found on the mainland, musk oxen, wolverines, and

marmots are not found here. Teeth of the first-named, however, were found in a settlement in Kuk; and, according to the Eskimos, there is a musk-ox skull in a house ruin on the south shore. The caribou are still numerous and are said to be of an unusually large variety. In the winter they gather together north and east of South Bay, in the summer they are spread over the island, mostly, however, in the area of primitive rock. Bears are common and wolves very numerous in the caribou district, especially on Bell Peninsula; and there are many foxes, ermine, and lemmings. Formerly the south and west coasts were good whaling districts; now the walrus are numerous in Duke of York Bay and several places on the west and south coasts. There is a rich bird life; especially in the flat, marshy districts towards the southwest, where there are many waders and swimmers. There are four kinds of salmon trout in the rivers and lakes; the most important salmon lakes are Hansine and Qeqertauarlik.

According to the Eskimos, Southampton Island is much the best country in this general region as far as game is concerned. Formerly it was also comparatively well inhabited, as the numerous house ruins show. The inhabitants were of the peculiar Sadlermiut tribe already described. They disappeared earlier from the northern part of the island. The last members of the ancient tribe resided in the settlement Tunirmiut (Native Point) at South Bay. The island is now inhabited by about 30 Aivilik families, who spend the summer at Duke of York Bay or at South Bay, where in 1924 the Hudson's Bay Company established a station, and the winter in the caribou district.

CONCLUSION

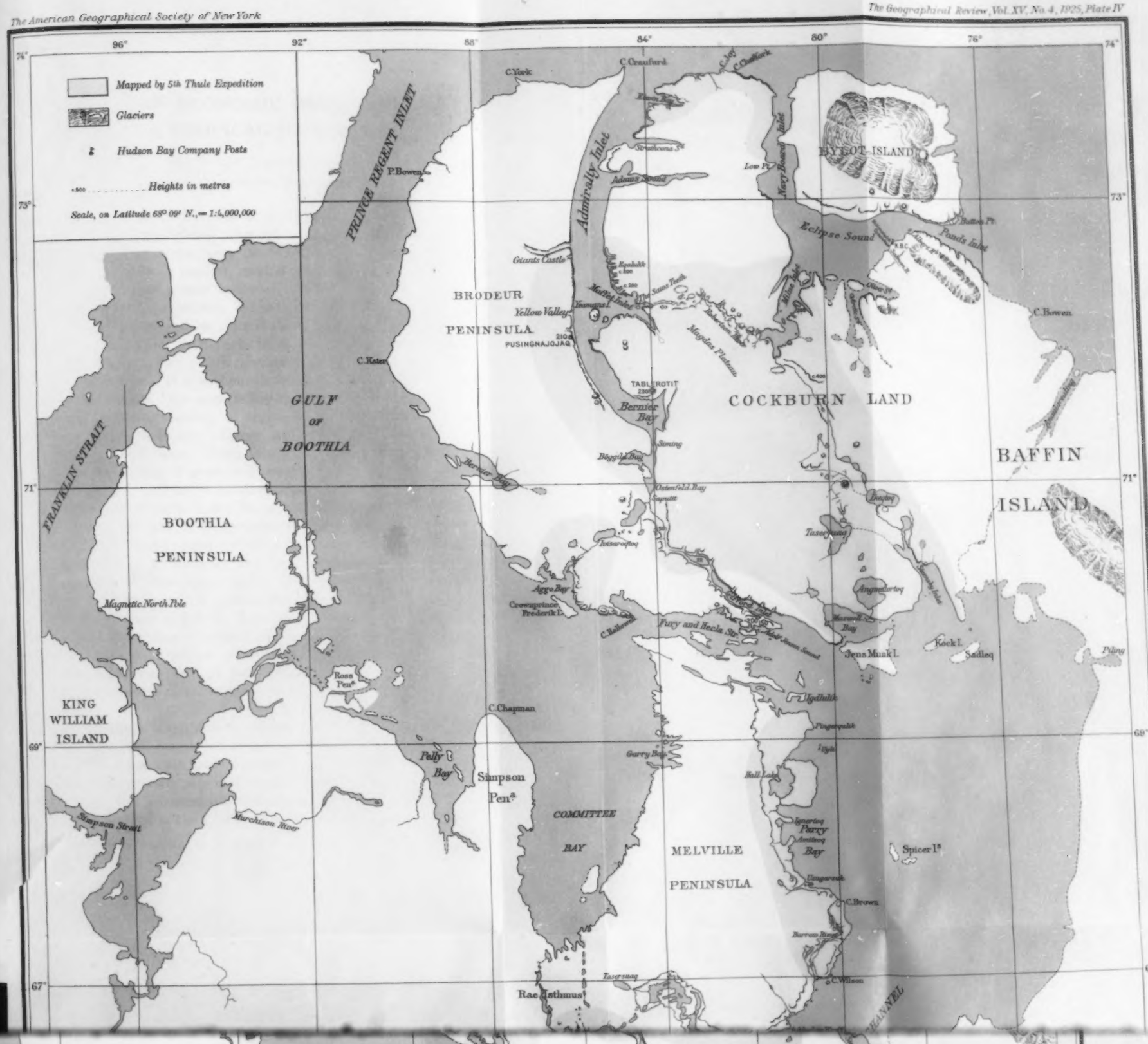
In conclusion other results may be very briefly noted. The meteorological work was handicapped by shipwreck on leaving Greenland, when we lost nearly all our instruments and had to replace them in haste with such apparatus as was available. The longest continued series of observations comes from our headquarters, Danish Island, north of Vansittart Island. It extends over about two years with some few short interruptions at times when we all left the station It includes a detailed weather report and thermometric and barometric readings three times a day. There are shorter series of observations from those places where we camped for a considerable period, for instance Baker Lake, Ponds Inlet, etc.; and we also made observations while traveling.

The botanical and zoölogical results include a series of phenological observations. Of special interest is the fact that there are complete collections of plants from a number of localities practically in a line from north to south: Ponds Inlet, Repulse Bay, and Vansittart Island, Eskimo Point, and Churchill; the Northwest Passage is represented by King William

Land, and Alaska by Point Hope. Although we had at headquarters a motor boat intended for hydrographic and marine zoölogic studies, the ice conditions around the island prevented us from using it. The animal life of the ocean is, however, represented by some dredgings in Frozen Strait, south of Vansittart Island. We obtained considerable collections of furs and skeletons of mammals and birds, as well as of insects and arachnida, in general from the same locations as the plant collections.

The collections of the expedition numbered about 20,000 objects of which 15,000 are ethnographic and archeologic—many, as we have indicated, from tribes among whom collections have never been made before. In Copenhagen there already existed smaller but good collections from Greenland. Now we shall be able to show a comprehensive view of Eskimo civilization as a whole from Denmark Strait to the Pacific shores.

A Danish name was connected with the exploration of Hudson Bay 300 years ago when Jens Munk spent a winter at the mouth of what has later become known as Churchill River but which even as late as the eighteenth century was marked on the map as "la rivière danoise." We also come upon the name of a countryman in the opposite corner of North America, Vitus Bering, who discovered the coast of Alaska. It has fallen to our lot to draw the line between these two names, and in gratitude to the country that enabled us to set out and to the two great nations that permitted us to complete the trip, I have the hope that in this way there has not only been added a stone to the Temple of Science but that there has also been taken a step toward advantageous coöperation between the nations.


Mapped by 5th Thule Expedition
Glaciers
Hudson Bay Company Posts
Heights in metres
Scale, on Latitude 68° 09′ N., = 1:4,000,000
96°
92°
88°
84°
80°
76°
74°
73°
71°
69°
67°
PRINCE REGENT INLET
Admiralty Inlet
BYLOT ISLAND
Eclipse Sound
Pond Inlet
BRODEUR PENINSULA
FUSINGNAJOJAQ
COCKBURN LAND
BAFFIN ISLAND
GULF OF BOOTHIA
FRANKLIN STRAIT
BOOTHIA PENINSULA
Magnetic North Pole
KING WILLIAM ISLAND
Simpson Strait
Pelly Bay
Simpson Penª
COMMITTEE BAY
MELVILLE PENINSULA
Spicer Iª
Rae Isthmus
Fury and Hecla Str.
Jens Munk I.
Sadleq
Piling
Parry Bay
Bernier Bay
Ross Penª
C. Chapman
C. Kater
C. Bowen
C. Brown
C. Wilson
C. York
C. Crauford
P. Bowen
Giants Castle
Yellow Valley
TABLEROTIT
Magdas Plateau
Ostenfeld Bay
Aggo Bay
Crowsprince Frederik I.
C. Ballowe
Garry Bay
Ball Lake
Marchison River
Tasersuaq
Barrow River
Adams Sound
Low Pt.
Navy Board Inlet
Button Pt.
Ottawa Is.
Saxe Teeth
Yamyma I.
Millar Inlet
Angmerdleq
Kock I.
Maxwell Bay
Ingerlaq
Amitteq
Tingerarsuk
Ugjulik
Pingerqualik
Ikyle
Boggild Bay
Saqvitt
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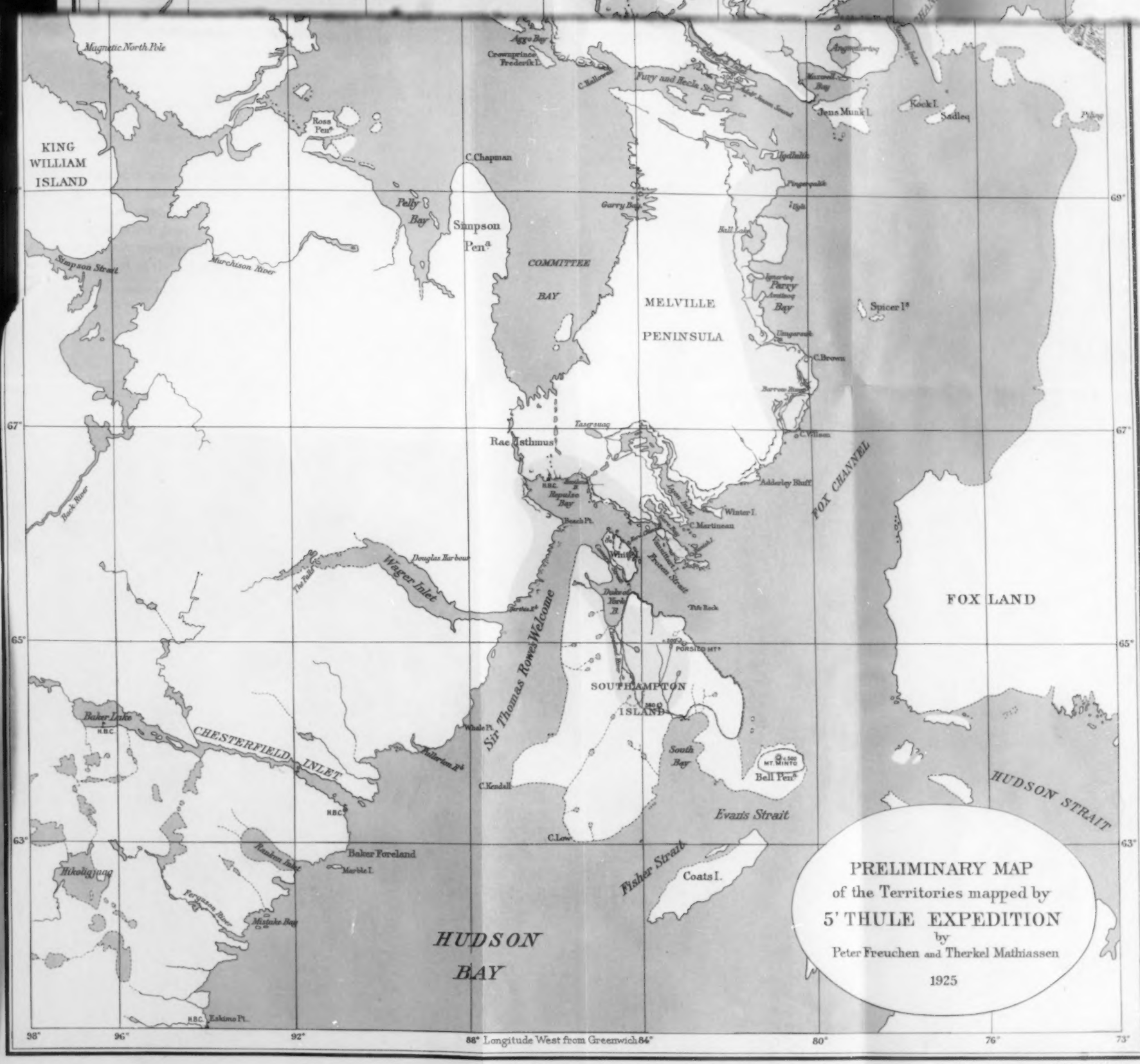

PRELIMINARY MAP
of the Territories mapped by
5' THULE EXPEDITION
by
Peter Freuchen and Therkel Mathiassen
1925

A. HOEN & CO.

JAVA: THE ECONOMIC GEOGRAPHY OF A TROPICAL ISLAND*

By S. VAN VALKENBERG
Topographical Service, Batavia, Java

Java affords a beautiful example of the development of a tropical island under nearly ideal conditions. An advantageous geographical position between Asia and Australia, near the Strait of Malacca, the great trade route to the Far East; a regular, moderate climate with plenteous rains, and no long dry season; a very fertile soil, mainly of recent volcanic origin; a race which is, for the tropics, industrious; and a modern and not unpopular colonial system—these contribute to give Java an importance and a world name far greater than might be expected from its small size.

Java is distinguished by a high percentage of cultivated land and a high density of population. It is without doubt the most intensively cultivated country of the tropics. We may reckon roughly that 80 per cent of the soil is productive. The remaining 20 per cent, which includes also the area occupied by roads, railroads, villages, and so on, is found for the greater part along the south coast. Even this is not wholly unproductive, being suitable for the rearing of goats and sheep. In some places, especially in southern Preanger, such areas are diminishing rapidly.

The population density is the highest in the world for a country depending almost entirely upon agriculture. Java has an area of 131,440 square kilometers (50,750 square miles, a little more than New York State) and a population of 35 millions, that is a population density of 266 per square kilometer (688 per square mile). The density varies between 63 per square kilometer in the rough mountainous region of southern Bantam and 683 in the fertile plain of Jokya. Java has no industries of importance nor any great agglomerations of manual labor in the towns. The people living in towns of more than 50,000 inhabitants form only about 3 per cent of the total as compared with 31 per cent in the United States. Table I shows the population of other agricultural countries in comparison with Java.

The case of Egypt is not strictly comparable for the area given is that of the fertile Nile valley and delta: territorial Egypt is ten times the size. India and China are vast areas covering a great variety of terrains. The most densely populated province of the former is Bengal, which, as the table shows, is closely comparable with Java. Java also compares with the most densely peopled of the Chinese provinces. In Japan the most densely

* The writer is deeply indebted to Mr. C. L. Hoover, Consul General for the U. S. A., for suggestions regarding the manuscript.

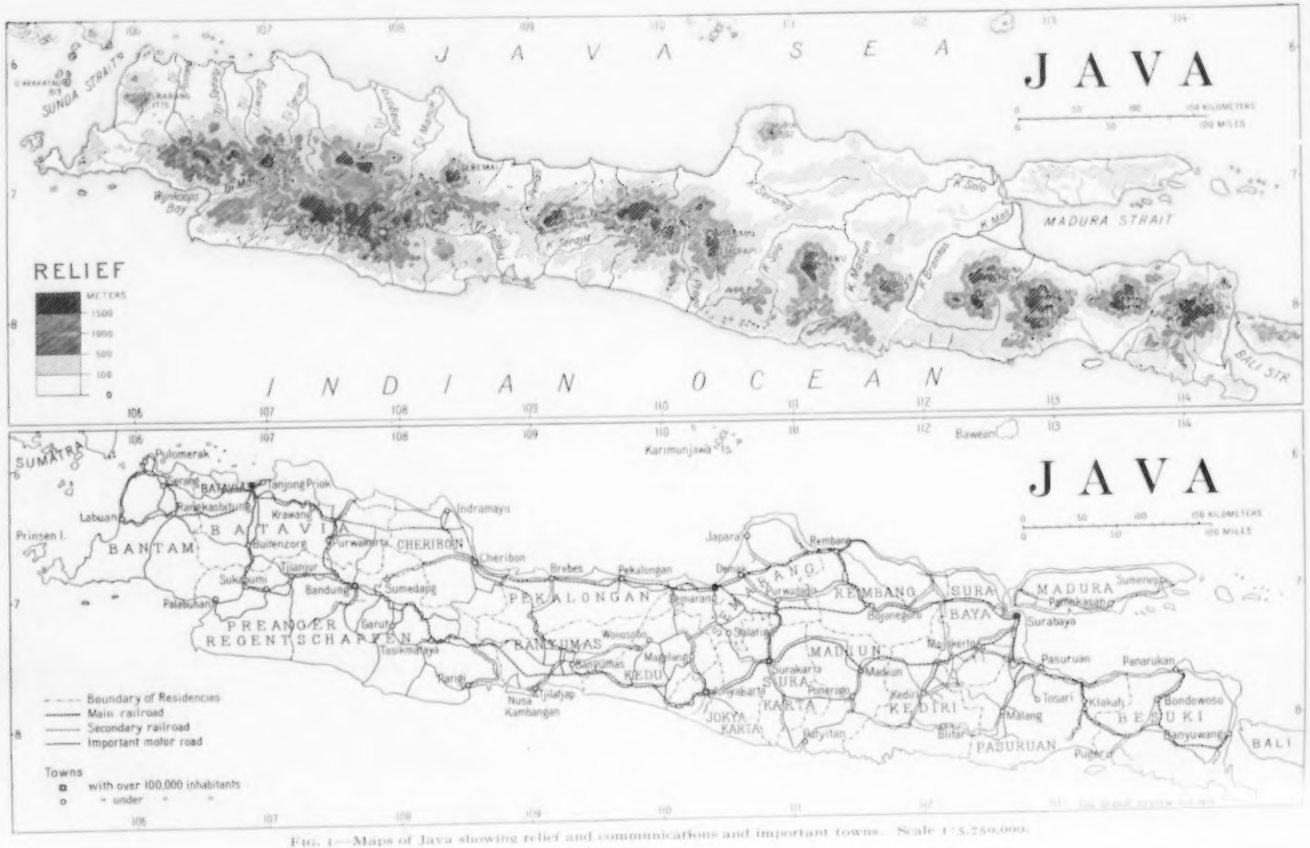

FIG. 1—Maps of Java showing relief and communications and important towns. Scale 1:5,250,000.

peopled divisions are industrialized: Kinki includes Osaka; Kwanto includes Tokyo. In the western hemisphere the only comparable unit is Porto Rico, but this island is not one-sixteenth the size of Java. The contrast with Cuba is especially striking; we shall mention it again later.

TABLE I—AREA AND POPULATION DENSITY OF VARIOUS AGRICULTURAL COUNTRIES[1]

COUNTRY	AREA IN SQUARE KILOMETERS	POPULATION PER SQUARE KILOMETER
Egypt	35,363	360
India	4,667,680	68
Bengal	203,830	229
China (proper)	3,877,000	106
Kiangsu	99,300	340
Chekiang	91,200	242
Shantung	149,600	206
Japan	385,521	187
Kinki	23,220	323
Kwanto	32,275	345
Philippines	297,917	35
Cuba	114,524	25
Porto Rico	8,897	146
Java	131,440	266

The high density figure in Java has been attained comparatively recently, largely through the peace brought to the island by Dutch rule in the last century. Table II gives approximate figures showing this progress.

If the influenza epidemic had not affected Java the total population would have been at least a million greater. In fact we may say that Java is on its way to the highest point of typical evolution among tropical countries. Especially interesting is the change of density in the last 25 years (Fig. 3). The two districts showing a small decrease and some with only a small increase seem to have reached saturation point, which in Java depends on the fertility of the soil and on the possibility of irrigation. For instance, in the eastern district of the island of Madura, northeast of the main island, the saturation point seems to be 284, while on the volcanic alluvial plain it easily exceeds 600. Increase has been greatest in the more remote districts which are now beginning to be populated by emigration from other parts. The high figures along the southern coast of East Java indicate the

[1] Figures from Henri Bunle: Superficie et population des contrées de la terre, vers 1920, *Bull. l'Inst. Internatl. de Statistique*, Vol. 21, 1924, Part II, pp. 281–338.

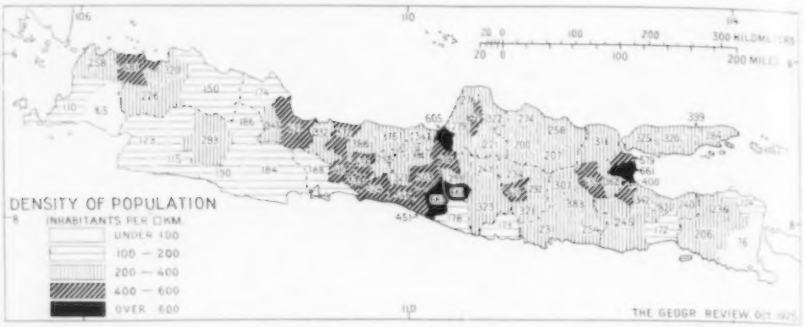

FIG. 2—Cartogram showing density of population according to the census of 1920. Scale, approximately 1:9,500,000.

influence of the sugar industry at the foot of the volcanoes, the coast and the bordering hinterland remaining sparsely populated. Another good example is to the north of Cheribon on the north coast, where the delta of the Tjimanuk has been made suitable for the cultivation of rice and where sanitary conditions have been greatly improved. In the Preanger Regencies the number of estates has increased to the south, especially south of Bandung, and population has correspondingly increased.

In future we may expect a still further increase until the now sparsely populated districts have reached their maximum density. A population of 50 to 60 millions will have to be reckoned with. Meanwhile the question of emigration will soon prove urgent, and the Government hopes that the island of Sumatra (415,382 square kilometers and 14 people per square

TABLE II—GROWTH OF POPULATION IN JAVA

YEAR	INHABITANTS	PER SQUARE KILOMETER
1800	3 to 4,000,000	30
1850	11,000,000	90
1900	28,000,000	225
1920	35,000,000	266

kilometer) will serve as an area of absorption of the surplus Javan population.

COMPOSITION OF POPULATION

Of the 35 million inhabitants of Java more than 34 million are natives, 415,000 being foreign Orientals and 135,000 Europeans. The foreign Orientals are for the greater part Chinese. Most of them belong to the middle classes and carry on a retail trade, but many by their diligence and economy have grown rich and become proprietors of large commercial concerns, estates, and factories. The number of Arabs is increasing; they

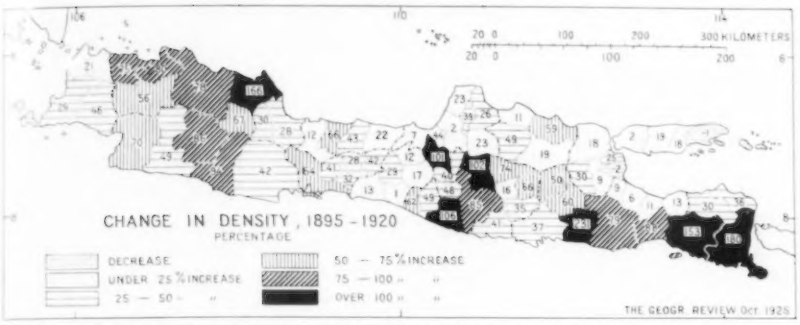

FIG. 3—Cartogram showing changes in density of population 1895–1920. Compare with Figure 2.

too are for the greater part retail dealers, especially in the towns. Of the 135,000 Europeans the great majority, 127,000, are of Dutch origin; but not all are of pure European blood, for no sharp distinction between pure whites and those of mixed blood is made here as it is in India.

For the greater part the white population live in the towns, which are mostly European settlements. Batavia with its suburbs has 300,000 inhabitants, of whom 31,000 are Europeans. Semarang has 160,000, of whom 18,000 are Europeans. Buitenzorg has 5,000 Europeans. Bandung has 100,000 inhabitants, of which number 10,000 are Europeans. Furthermore there are a few smaller towns, as for instance Garut and Sukabumi

TABLE III—DEATH RATES IN JAVA AND NEIGHBORING COUNTRIES

COUNTRY	AVERAGE YEARLY DEATHS PER THOUSAND OF POPULATION	DEATH RATE IN 1918 (INFLUENZA EPIDEMIC)
Java	20	36
India	30	62.4
Philippines	23	41
Federated Malay States	32	53

and Malang, that, as healthful mountain resorts, are favored a good deal by retired Europeans. Solo, or Surakarta, and Jokyakarta, having respectively 135,000 and 103,000 inhabitants, are the only real native towns; but both have rather large white communities. Each of these last two towns is the capital of a Sultanate, formerly independent.

In connection with the population a few words should be said regarding demographic conditions. Generally speaking, and in comparison with the surrounding countries with the sole exception of Australia, health conditions

in the Dutch East Indies are not unfavorable if one judges by the average yearly death rate. Since 1912 the death rate in Java and Madura has been carefully checked and mortality statistics compiled, and the same has been done with regard to the birth rate. The average yearly death rate is found to be about 20 per 1000, or not far from that of Japan. In 1918, the year of the influenza epidemic, this figure rose to 36 per 1000, but it soon dropped until 20 was reached again in 1922. In Table III figures for some of the surrounding countries are given by way of comparison.

The towns, especially those on the northern coast of Java do not show such favorable figures as the rural districts, a fact which is also observed in surrounding countries. The yearly mortality figures of Batavia, Semarang and Surabaya for the last ten years fluctuate between 40 and 60 per 1000, those of the inland towns being on the whole much more favorable. The figures given above all refer to the native population.

For the European population the rates are far more favorable and approximate those found in towns of Europe and America. The average yearly death rate for the European population of Batavia, Semarang, and Surabaya during the last ten years is 16, 19, and 18 per 1000 respectively. Such rates, however, cannot be compared with those of the countries of Europe. The so-called European community in Java réally contains a large measure of Javanese blood, and furthermore the pure Europeans are a more or less selected group. The children and women are often sent away from Java because the climate does not agree with them. So too are many men who show signs of ill health. Those who remain are on the whole strong individuals, many of whom are at the most vigorous ages. At home the death rate among such people would probably not be much more than half as high as the actual rate in Java, for Holland as a whole has a rate of only about 13 (13.9 from 1906 to 1913, and lower since 1920).

We shall now examine briefly the physical and economic bases of this flourishing population.

Structure and Topography

Java owes its existence to a huge fold in the crust of the earth. This is called the Sunda fold, and it is part of a great arc of the earth along which disturbances have been continued during late geological time in the Malay region. The effect has been to bow a portion of the crust above the surface of the ocean in a system of folding similar to that in the Alps and the Himalayas. Sumatra and the Sunda Islands, like Java, are the end result of this deep-seated crustal disturbance. In these facts are to be found the explanation of the disposition of the rocks and soils and to a large degree the distribution of the population.

The old rock formations have been folded up to form the high mountains, and wherever the dislocation or bending of the crust of the earth has produced ruptures, there volcanoes burst forth. The action of the weather

upon the volcanic mountains resulted in their deep erosion and the covering of the whole surface with a thick layer of tropical soil called laterite. The products of erosion were deposited in the bordering shallow seas as conglomerates, marls, and sandstones. In addition limestone reefs were formed. Further bending or bowing of the earth's crust resulted in the uplift of the marginal areas which turned the reefs into dry land and resulted in a system of relief, drainage, and soils characteristic of limestone regions and

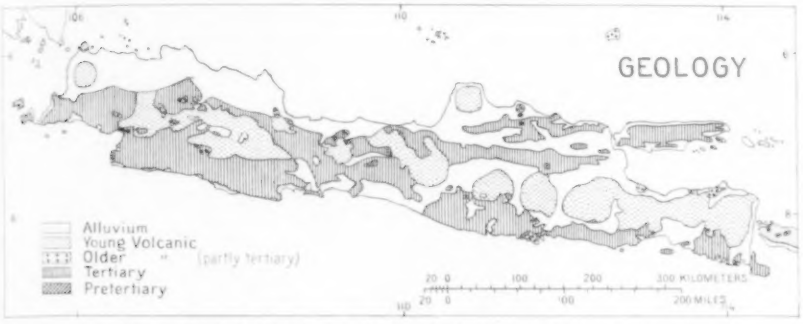

FIG. 4—Geological sketch map of Java. Scale approximately 1:9,500,000.

known technically as "karst" country. The shallow-water marine deposits that were uplifted now form pronounced terraces on the southern coast. The limey reefs have been weathered down, and they are also covered with laterite like the older volcanic deposits to which we have referred. Volcanic activity has continued down to the present time, and it clearly demonstrates that the processes of bowing and rupture and their accompaniments of volcanic activity have not yet run their course.

The entire northern coast of Java, with a few exceptions, is an alluvial plain which, where not covered with laterite, is classed among the most fertile rice and sugar soils of the island. In contrast with the closed south coast Java lies open towards the north. Here the principal commercial towns are situated, although natural harbors do not exist, and the continual silting makes the construction and maintenance of artificial harbors expensive undertakings, Tanjong Priok (the harbor of Batavia) and Surabaya being good examples.

Between the northern plain and the central complex of volcanoes a hilly Tertiary district is found of considerable extent in East Java.[2] This terrain is relatively unproductive and, apart from native secondary crops, is largely devoted to the culture of *jati* (teak) trees.

The numerous volcanoes of West Java form a kind of network enclosing high plains filled with volcanic ash, such as those of Bandung and Garut. In East Java they are more widely separated. Notwithstanding the disas-

[2] Java is commonly divided into East Java, east of the Semarang; Central Java; West Java, west of the Cheribon.

trous eruptions, the volcanoes must be considered a veritable gift of the gods. Their fertile ashes have, to a large extent, covered the Tertiary laterite and made of Java a real garden of the East.

Crops cover the slopes of the volcanic cones to a considerable height, and above the limits of cultivation the remaining primeval forest constitutes a valuable reserve. These volcanic giants have also been beneficial in another direction. Through their great height they promote rainfall during the west monsoon, providing also during the dry season considerable quantities of water for the irrigation of the surrounding plains.

The mountains of Tertiary limestone and conglomerate along the southern coast are quite different from the central volcanoes. Broken at only two places, this mountain range, very rough in places though not lofty, has entirely closed Java on that side. The only harbor, Tjilatjap, is insufficient to provide satisfactory commercial intercourse for the south coast. On the whole, these mountains do not hold out much promise for the future so far as East Java is concerned, but the situation is more hopeful as regards Bantam and Preanger in the west. The extension of the European plantations, more particularly of rubber, has to a considerable extent already opened up this district from the north. The still uncultivated forest-covered areas may prove important in the future. At present the population is sparse, and only the valleys are cultivated.

Only a word is needed about minerals, which naturally stand in close relation to the geological structure. In contrast with the other islands of the archipelago Java is very poor in this form of wealth. The only mineral of economic importance is oil, found in Rembang and north of Surabaya. Production, however, is hardly sufficient to meet the requirements of Java itself.

Climate[3]

The whole of the Netherlands East Indies belongs to the tropical zone, the boundary of which is taken to be the yearly isotherm of 20° C. (68° F.). The climate of this zone, which covers nearly half the globe, is rather uniform, but it includes significant differences that are often overlooked. As regards the effect of climate on man a distinction should be drawn between a climate with a mean temperature of 20° and another of 28° (82.4° F.). With a temperature approaching the limit of human endurance, as is the case in the low-lying plains, the influence of a change of a few degrees is very striking. In Java health resorts are widely distributed on the slopes of the volcanoes, their altitudes ranging between 500 and 1800 meters (1650 and 5900 feet). Every white man goes to a health resort for a few weeks each year if possible; the civil officers, for instance, get an annual two weeks' holiday; women and children generally stay longer.

[3] Based on C. Braak: Het klimaat van Nederlandsch-Indië (The Climate of the Netherlands Indies) (With English Summaries), Batavia, 1923—. Of this work eight parts, forming Volume 1, have already been published, the first four of which were reviewed in the *Geogr. Rev.*, Vol. 14, 1924, p. 496.

FIG. 5

FIG. 6

FIG. 5—Tea plantation of Pamegatan, near Garut, at an altitude of about 5000 feet. (This and the following photographs are by courtesy of Th. Weissenborn, Garut, Java.)
FIG. 6—Rice fields near Garut, central volcanic plateau of western Java.

The Rainfall

The Malay Archipelago is the typical monsoon region of the world. In Java we find a time of pronounced east to southeast wind, the so-called east monsoon, in the months of December, January, and February, and a time of pronounced west to northwest wind, the west monsoon, in July, August, and September. The months between have changeable winds. Usually the strength of the wind does not exceed that of a gentle breeze. Even in January and August, when the monsoons are steadiest, their direction is by no means constant. With the exception of the main sea, the deviations from the general monsoon current are usually more marked than the monsoons themselves. Local winds, which owe their existence to insolation and the mountainous character of the country, are strongly developed; and, near the coast, land and sea breezes are pronounced.

The division of seasons is marked, the east monsoon giving the dry season, the west monsoon the wet season. The intensity of the wet season decreases eastwards (toward Australia), and the intensity of the dry season increases: East Java has less rain than West Java (see Fig. 7). The rainfall usually increases strongly toward the mountains, an increase due to thunderstorms as well as to the fact that the winds are forced to rise. A well-known instance is the heavy increase of rainfall between Batavia and Buitenzorg—2600 millimeters in a distance of 50 kilometers.

The distribution of cloudiness and sunshine is similar. On an average for the year the sunshine is about 60–70 per cent of the total possible in the western plains and 70–80 per cent in the eastern plains; in the mountains it decreases to 30–40 per cent.

In exceptionally heavy thunderstorms the intensity of the rainfall in the tropics does not exceed that of similar showers in Europe, but the number of local thunderstorms is much greater, as is also the mean intensity of the rainfall, showers giving 50 millimeters (2 inches) of rain being rather frequent. The maximum rainfall for longer periods is high, the highest maximum being 511 millimeters in 24 hours, while the highest in Europe, according to Hann, is 345 millimeters (13.5 inches).

As a rule, the high mean monthly totals of rainfall are largely dependent on what may be called the local convective effect of the mountains. The rain maps of January and August, when compared with the relief map, give beautiful examples of rain produced in this way during each of the two monsoons. During the daytime, when there is little wind, the mountains act as centers of a strong ascending air movement and consequently give rise to relatively heavy condensation. When the wind is blowing the rainfall on the windward side of the mountains increases and on the lee side decreases. This contrast between the two sides of the mountains is most distinct and may even reverse the rainy season, as appears in Preanger on the southwest coast. Here the January map shows a maximum rainfall in the west of the province, whereas elsewhere the maximum comes in the other half of the year, as appears in the August map.

As regards the yearly rainfall, an amount above 3 meters (118 inches) can be regarded as being very high and occurs only along the mountain slopes.[4] The zone of maximum rainfall occurs about 1200 meters (4000 feet).

For a tropical island the seasonal division of rainfall, especially the amount of rain during the dry season, and the length of the dry periods are of the utmost importance. We have described how convection and thunderstorms produce enough rain in the mountain regions even during the east monsoon, but on the plains the drought is sometimes severe. The average number of months with less than 50 millimeters of rain ranges from one to two on the plains of West Java and from three to four on the plains of East Java; in a few spots the dry period endures six to seven months. During these months cultivation without irrigation is, of course, impossible.

Temperature and Humidity

The temperature depends almost wholly upon altitude: the seasonal variation is very small. For Batavia, for instance, the month having the lowest average temperature is January with 25.3° C., and that having the highest is May with 26.3° C.—a difference of one degree.

The average temperature at different altitudes in Java may be represented approximately by the formula $t = 26.3° - 0.61h$, in which h is the height in hundreds of meters. Table IV is illustrative.

Table IV—Temperatures and Altitudes

Place	Altitude		Average Yearly Temperature	
	Meters	(Feet)	C.°	(F.°)
Batavia	8	(26)	25.9	(78.6)
Buitenzorg . . .	240	(788)	24.8	(76.6)
Bandung	730	(2395)	22.1	(71.2)
Tosari	1735	(5588)	15.9	(60.6)
Gede	3023	(9914)	8.9	(48.0)

In the latitude of Batavia the isotherm of 0° C. lies on an average at a height of 4750 meters, far above the altitude of the highest summits. Frost does not occur at night on the unsheltered mountain tops, but in the mountain valleys and on high, enclosed plateaus where calm nights are the rule frosts occur frequently during the dry months, even at an altitude of 1500 meters, and damage the tea plantations.

The relative humidity changes with the seasons but is always high. As a rule it remains between 85 and 90 per cent, and even in the driest month the mean relative humidity for Batavia is 78 per cent. The readings of the

[4] The highest recorded annual rainfall is 6829 millimeters (278 inches) at Kranggan in the mountain saddle west of Mt. Slamat.

wet bulb give a good indication of the effect of temperature and relative humidity combined. Generally speaking, the weather in Batavia becomes oppressive when the wet bulb temperature rises above 25° C. (77° F.), and then the heat becomes troublesome even in sedentary occupations; when the wet bulb reading exceeds 26° complaints about the heat are general. Fortunately, wet bulb temperatures above 26° are more the exception than the rule. Because of the small change in humidity the wet bulb temperatures are also rather constant and do not differ much from the ordinary temperatures; hence climographs, such as are shown by Griffith Taylor for Australia, are of little value for Java.

As a whole, the climate of Java is not unsuitable for white men living in cool houses, wearing lightweight, white clothes, and not doing hard physical work. In the busy harbor one does not get the impression of tropical lassitude about which one reads so often. In the mountains the climate is excellent; the only drawback—one that exists everywhere and always—is its uniformity, for a change of seasons exerts a stimulating effect on the energy of white men.

Irrigation[5]

For an agricultural country like Java, irrigation is of course of the greatest importance, the cultivation of both rice and sugar depending practically entirely on it. The rivers in Java nearly all have short courses and limited catchment areas. The largest, the Solo River, although running almost across the island, has a basin of only 15,400 square kilometers.

The water supply from the rivers is very irregular. As example we may take the Solo River. The approximate flow per second at normal highest mark is 70,000 cubic feet, during extraordinarily heavy floods 90,000 cubic feet, and at normal lowest mark 810 cubic feet. The river is of a deep brown color, as are most of the Java streams. The quantity of mud carried is 3 10/16 ounces per cubic foot (the Mississippi at New Orleans carries 2 11/16). Consequently there is a strong tendency to form relatively high strips, or natural levees, along the banks in the lower course after inundations. The larger rivers of Java's north coast all form deltas, which grow at a rapid rate. In the case of the Tjimanuk delta an increase of three kilometers has been observed during the last forty years. Everywhere the lowlands are diked. The south coast, for the greater part, is bordered by a mountainous ridge descending steeply into a deep sea, which practically everywhere has a strong surf. Hence no deltas are found.

The district irrigated by a given river is subdivided into secondary squares, which as a rule are bordered by discharge canals whose size depends on field conditions. The secondary squares are again subdivided into tertiary squares, the so-called terminal squares. In these terminal

[5] In this and the following sections use has been made of many official and other sources of information, including the "Handbook of the Netherlands East-Indies," Buitenzorg, 1924.

squares, whose size has lately been fixed as generally as possible at about 100 hectares, the irrigation water is conducted onto the land directly from the so-called tertiary canals. The irrigation canals are provided, wherever necessary, with gauges for proportionate division of the water.

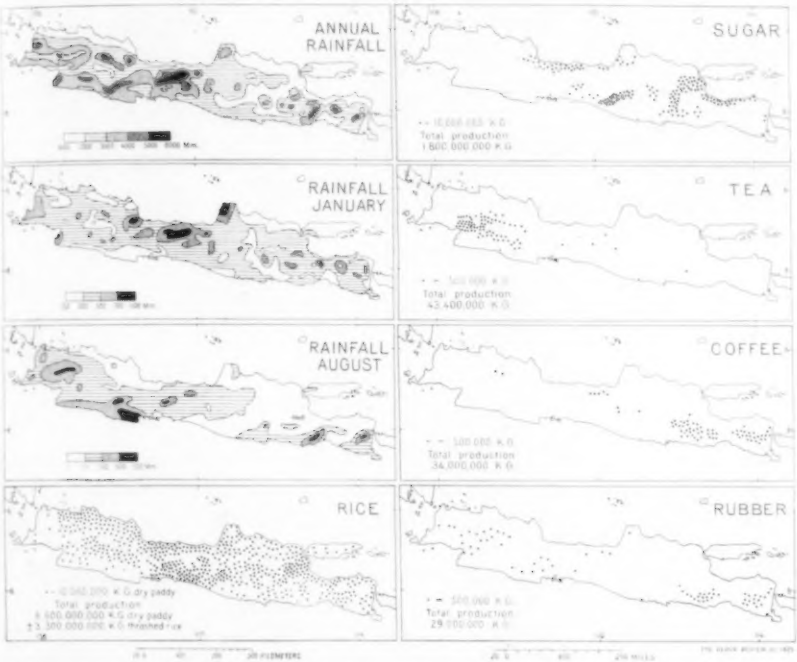

FIG. 7—Rainfall and distribution of the chief crops of Java (units of production represented by a dot, and total production given in kilograms on each cartogram: figures for 1923). Scale approximately 1:19,000,000.

The capacity of the canals is regulated according to the crop requiring most water, namely, rice; for this crop the fields must remain inundated for some time. The quantity of water depends in the main on the porosity of the soil, the gradient of the land, and the height of the ground water, which again depends on the local rainfall. On an average a supply of 1.5 liters per hectare per second for the full period of irrigation can be considered as sufficient in the plains. The comparatively small quantity absorbed by the plant during its growth and the quantity lost by evaporation (about 0.45 liters per hectare per second during the west monsoon, the season when rice is chiefly grown) may be considered as practically stable for the whole of Java.

The magnitude of the irrigation and flood-control work may be judged from the fact that the irrigated districts for which permanent works are now in use have an area not far short of 803,000 hectares (2,000,000 acres), while districts for which permanent works are under construction or

FIG. 8.—The temple of Sawal, near Jokyakarta. To the left rice fields ready for harvest.

are being planned amount to 783,000 hectares. The expenditure on irrigation, drainage works, and flood control in 1922 was more than 10,000,000 florins (the par value of the florin or guilder is 40 cents).

NATIVE AGRICULTURE: RICE

Rice is the main product of Java and the staple food. How universally it is raised may be judged from the map, where only the most rugged areas are blank. There are two principal methods of cultivation in Java, viz. culture on non-irrigated fields, still carried on in sparsely populated mountain districts, and the general method of culture in irrigated fields, which are laid out in terraces surrounded by low dikes to retain the water. Cultivation is partly dependent on rain, but wherever possible irrigation is applied. Rice fields are found in the mountains up to altitudes of 1200 meters as well as in the plains. The Javanese even manage to convert slopes with a gradient of 45° into terraces for rice culture. The size of the separate fields, surrounded by dikes, varies from a few square meters to a number of hectares (the hectare = 2.47 acres). In 1922 about 3,000,000 hectares of irrigated land, or about 23 per cent of the whole area of Java, were used for paddy fields. In addition some 350,000 hectares were planted with dry paddy, but this rice is of inferior quality. The young rice plants are set out in the inundated fields at the beginning of the rainy season, the harvest taking place about the beginning of the dry season. During the remaining months, on good rice fields, secondary crops such as Indian corn, cassava, and so on are planted; but very often the fields lie bare until the next season. On the mountains the cultivation of rice goes on without interruption; no special harvest time is observed there, and one can always see rice in all states of growth. Java, even with a production of 3,300,000 tons, does not grow enough rice to feed its inhabitants, although the food of the natives in Java is not so one-sided as it is with most other rice-eating

FIG. 9 — Oxen plowing an irrigated rice field.

people. In 1923 rice worth 24,000,000 guilders was imported, but this was partly balanced by an export of 4,000,000 guilders' worth, for Java rice is of very good quality.

Importation seems to be the final recourse in all rice-growing countries. Rice culture alone cannot support a higher density of population than from 200 to 250 per square kilometer; and, the moment the density increases, importation of rice begins. Bengal is a good example of a rice country just on the borderline of self-support. It has 46,700,000 inhabitants; a density of 229 per square kilometer; a rice area of 8.5 million hectares, being 80 to 90 per cent of the total area; and an average rice production of 586 kilos per hectare, or 185 kilos per inhabitant. That production is nearly all consumed; a higher density of population would necessitate imports.

Burma, Siam, and Indo-China are the great rice-exporting countries of the East, all three having a relatively low density of population and immense rice fields. The average yield per hectare of the two former is about the same as in Java, in Indo-China a little lower. Japan has to import rice and is endeavoring to become self-supporting by increasing rice cultivation in Formosa and Korea. In the Philippines rice production, especially the yield per hectare, is still meager, and the import amounts to one-fifth of the production.

Perhaps in the future it may be possible to improve the yield of rice. In Japan it is twice as high as in Java. Up to the present, however, the Government's efforts have not succeeded, as the natives are very conservative.

OTHER NATIVE CROPS

A number of other important crops partly take the place of rice as food—Indian corn (1½ million hectares), cassava (719,000 hectares), sweet potatoes, turnips, peanuts, and so on. The export of cassava is of much importance, in 1923 being 22½ million kilograms of dry roots, 70 million

kilograms of flour, 5½ million kilograms of flakes, and 12 million kilograms of pearl tapioca. The flour goes chiefly to the United States of America.

Another important product is copra. It is difficult to give an idea of the number of coconut trees in Java. A census held in 1917 gave a total of 63,000,000, but at present there are certainly far more. There are also unnumbered tropical fruit trees, but there is no fruit exported except bananas.

Plantation, or Export, Crops

The sugar industry easily occupies first place among the crops grown primarily for export. After Cuba, Java is one of the most important exporters of cane sugar. Sugar is cultivated on the great alluvial plains of Central and East Java (Fig. 7). Sugar estates like those in Cuba scarcely exist, however. The sugar companies in general lease the ground from the natives once in three years for cultivation of a single crop. The Government does not permit the rice area to be diminished greatly nor foreigners to buy the fields. Because of this policy and because of the density of population it does not seem possible to enlarge the area planted to sugar cane to any extent, in contrast with Cuba where much good virgin soil is still available and where the population density is low. Realizing this limitation the sugar producers early aimed at increasing the yield. The Associated Experimental Station for the Java Sugar Industry was established at Pasuruan. As a result of its influence the average yield per hectare is now 11.18 tons, which compares well with Java's neighbors, for example, Queensland, whose average yield is 5 tons, and the Philippines, where the average yield was 2.7 tons in 1918. Comparison with Cuba is difficult, as there the cane fields are not plowed up after each harvest but cropping is continuous for a number of years. The cultivation itself in Cuba is not very intensive because of the vast untouched areas available. The total production of the 182 sugar mills in Java in 1923 was about 1,820,000 tons, being about 10 per cent of the world's sugar production, while Cuba produced 3,600,000 tons.

Tea ranks second of the plantation products. It is grown generally at altitudes of 400 to 1500 meters, the lower estates producing more abundantly, the higher estates giving better quality. The limit of altitude is set by the night frosts. The scientific aspects of the cultivation are carefully studied at the Experimental Station for Tea at Buitenzorg. The number of tea estates is 256, with a planted area of 121,000 hectares; the production of the tea factories is over 40,000,000 kilos, of which nearly 90 per cent is from the estates and the rest is bought from the natives. Java tea production is 10 per cent of that of the whole world.

Probably no product, either in Java or elsewhere, has recently increased in area and value so rapidly as rubber.[6] In 1922 there were in Java 438

[6] Cf. the note "The Twentieth Century Transformation of the Rubber Industry," in the April number of the *Geogr. Rev.*, pp. 316–317.

estates with a planted area of 164,000 hectares, of which 60 per cent was in production. The whole production of Java, Sumatra, and Borneo was about 100,000 tons, or about 25 per cent of the world production; Java, alone, produced 7¼ per cent. The rubber estates are found at altitudes between 100 and 700 meters, the trees often being interplanted with coffee (East Java) and sometimes with tea (West Java). Related to the production of rubber is that of gutta percha from the government estate of Tjipetir.

Coffee, another of the so-called "hill cultivations," has for centuries been one of the exports of Java. Originally the famous Java coffee (*Coffea arabica*) was the chief variety cultivated. Owing, however, to the severe ravages of the coffee leaf blight (*Hemileia vastatrix*) it was decided to plant Liberia coffee. Even this plant did not prove immune to the disease. A stronger species was found in the Robusta coffee, introduced from Africa in 1901. At present another serious pest, the coffee beetle, is spreading in the producing areas. There are now in Java 278 coffee estates, the greater number in East Java, as coffee requires a good dry season. The area amounts to 47,000 hectares planted with coffee alone and 55,000 hectares mixed, chiefly with rubber. The coffee production of Java today, 34,000,000 kilograms, represents only three per cent of the world production.

Java tobacco, especially that from Jokyakarta and Surakarta (Territory of the Native Princes), has always had a very good name, although ranking after the famous Sumatra tobacco. The tobacco companies hire the land from the natives, as is the case with sugar. As the profits are not very large, it is not improbable that a number of tobacco companies will take up sugar cultivation instead as being more profitable.

One of the most interesting crops is cinchona, partly because Java supplies nearly the entire world production of quinine, and partly because the government itself is an estate owner. The large government estate, "Tjintiruan," is at the same time the cinchona experiment station from which seeds and seedlings are sold to other estates. The bark of the tree here yields twice as much quinine as that of the original tree found in Peru and brought to Java 75 years ago. The cinchona estates are nearly all in Preanger, mostly south of Bandung at an altitude of 1500 to 1800 meters. In 1923 the production of 125 estates with a planted area of 16,150 hectares was 8,800,000 kilograms. Java also provides a major share of the world's cocaine, 900 metric tons of coca leaves being exported in 1923.

Cacao production shows sign of decline, although the prices for Java cacao are very high. In recent years the cultivation of fibers, especially of sisal and kapok, has grown in importance.

Pastoral Industry and Forests

In proportion to the population the number of live stock of all kinds is very small. In 1923 there were only 273,000 horses, 2,986,000 cattle,

2,074,000 buffaloes, 97,000 pigs, 1,421,000 goats, and 842,000 sheep. The horses are mainly native ponies, diminutive in size and used in the towns and larger villages for pulling carriages. Pigs are kept only by Chinese, as the natives, being Mohammedans, consider them unclean. The native cattle are found principally in East Java, and they are crossed heavily with Bengalese cattle. The prehistoric-looking buffaloes are used in the rice fields throughout the whole of Java. Australian and Frisian cows are imported and are kept in the mountains to provide the Europeans in the cities with fresh milk. Java is much like Japan in the scarcity of its live stock and utterly different from Australia, which has nearly 100 times as many animals in proportion to the population. For comparison, Table V is given.

TABLE V—LIVE STOCK IN VARIOUS COUNTRIES

COUNTRY	LIVE STOCK (HORSES, CATTLE, BUFFALOES, PIGS, GOATS, SHEEP)	AVERAGE PER 1000 INHABITANTS
Java (1923)	6,851,000	196
U. S. A. (1921)	203,089,000	1,922
Australia (1919)	103,267,000	18,993
Holland (1919)	3,546,000	519
Japan (1918)	3,313,000	57

The *jati*, or teak, is by far the most valuable forest tree of Java: indeed all other trees are classed as wild timber. The teak forests are a government monopoly. They cover some 735,000 hectares, occupying the lower hill region (below 600 meters) of Central and East Java where there is a pronounced dry season. Teak is used for all purposes where wood is required, for it is durable and resists white ants. Most of the production is consumed domestically.

The forests of wild timber vary considerably in composition according to climate and altitude. Their chief present value depends on their hydrographic influence, the regulation of stream flow. The area of wild timber reserves is about 1,486,500 hectares.

INDUSTRY AND TRADE

The native industry of Java is practically limited to home products and is of no importance for export. The only exception is hat plaiting, the bamboo hats exported in 1923 amounting to 3,000,000 with a value of about 880,000 guilders. About 12,700,000 pandan hats, worth 1,142,000 guilders, were also exported. There are also a number of smaller industries, such as copper work and batik, principally for the home and tourist markets. European industries are only beginning and supply only part of the domestic demand.

FIG. 10

FIG. 11

FIG. 10—The ruins of Borobodur, near Jokyakarta, dating from about a thousand years ago and perhaps the most elaborate of the famous Hindu ruins of Java.

FIG. 11—Houses of bamboo matting at Kampong Papandak, not far from Garut. This type with curved roofs is characteristic of a small area on the western plateau.

In 1920 the value of exports reached the figure of 1,500,000,000 guilders, chiefly as a result of the high sugar prices. Then the great trade depression came, and in 1921 for the first time the trade balance was adverse. Recovery is now in progress, the figure for 1923 reaching 819,000,000 guilders. Of this total, sugar accounted for 60 per cent, tea 8 per cent, rubber 6 per cent; the other chief exports in order of magnitude being tobacco, tapioca, cinchona, coffee, copra. The bulk of the trade was distributed almost evenly among Japan, India, the United States (12 per cent each), England, and Holland (11 per cent each). The two great eastern *entrepôts* also claimed an important share, Hongkong 9 per cent and Singapore 6 per cent.

During the quite exceptional years 1920 and 1921 Javan imports amounted to some 800,000,000 guilders, a value falling rapidly to 500,000,000 in 1922 and 435,000,000 in 1923. Imports are of the usual type required by a tropical agricultural country. In addition we may note the considerable import of rice (5 per cent) to which reference has already been made. Textiles, with England as the chief country of origin, constitute by far the greatest item (28 per cent). The largest contributions from the United States are oil, automobiles, fertilizer, and paper. The oil import is quite illogical seemingly, especially the great import of kerosene: Palembang, on the island of Sumatra, has an export trade in kerosene greater than the American imports into Java. But the policies of the oil trusts (Royal Dutch Shell and Standard Oil) cannot be understood from a geographical standpoint. The paper import consists in the main of overissued newspapers, which are used by all the Chinese shops for packing purposes.

Since the war the largest share in foreign shipping in the Netherlands East Indies has been held by Holland, 44 per cent in 1923, followed by England with 35 per cent. Of the inter-insular trade 80 per cent is in the hands of Holland, England having 12 per cent. Direct steamship lines connect Java with all parts of the world except South America.

Railways and Ports

The road system of Java may be considered good, even without two connections in West Java, which are now under construction. The system consists of northern and southern main roads traversing the island longitudinally and six primary crossroads connecting them. From this system, secondary roads go in all directions. The roads are generally in fair condition, especially considering the torrential rains and the heavy traffic near the towns and in the sugar districts. Motor cars are popular in Java, among natives as well as foreigners, and regular services are in operation.

The railway system has a length of 5339 kilometers, of which 2839 are in the hands of the government and 2500 are owned by private companies. A scheme for electrification of the various state railway lines has been drawn up, and the plan is already being put into execution for the lines near Batavia. For comparison we give the following figures of miles of railway

per 1000 square miles of area: Java 60; India 20; United States 87. Per 100,000 persons the figures are: Java 9, India 12, United States 245.

Batavia, Semarang, and Surabaya are the principal ports of Java: Batavia mainly for the products of West Java, especially tea, rubber, pepper, cinchona; Semarang for Central Java, sugar and tobacco; and Surabaya for East Java, sugar, rubber, coffee, fibers. A number of smaller ports such as Cheribon, Tegal, and Pekalongan ship sugar.

The harbor of Batavia, Tanjong Priok, is situated about 9 kilometers east of the town, the old harbor having been abandoned because of silting. The depth of the channel in the new outer harbor is 9.5 meters at low water, and the port is entirely modern in its equipment. Batavia leads in tonnage of shipping and is the port for the regular mail service to Holland, but the trade movement is of less importance than that of Surabaya.

Surabaya has a good roadstead protected by the island of Madura, and recently a harbor basin has been constructed at considerable expense. A similar improvement is needed for the open roadstead of Semarang, where, during the west monsoon, traffic with the shore is sometimes entirely suspended.

Conclusion

The future of Java depends largely on the evolution of other tropical colonies, especially India and the Philippines. The Javanese, with few exceptions, is content with the present conditions of Dutch rule which assure him a quiet life, untroubled by war and famine. The great educational scheme in progress—nearly all the small villages have government schools—will make it possible to give the natives an increasing share in the management of the country's affairs.

SHANGTU, THE SUMMER CAPITAL OF KUBLAI KHAN

By Lawrence Impey

In Xanadu did Kubla Khan
  A stately pleasure-dome decree;
Where Alph, the sacred river, ran
Through caverns measureless to man
  Down to a sunless sea.
So twice five miles of fertile ground
With walls and towers were girdled round;
And there were gardens bright with sinuous rills,
  Where blossomed many an incense-bearing tree;
And here were forests ancient as the hills,
  Enfolding sunny spots of greenery.

Many of us remember those few lines of Coleridge as one of the landmarks of our youthful education in English literature, words of magic bearing us to some far distant fairy realm. But, alas, how few of those who thus traveled on wings of enchantment have ever had the opportunity to behold the country of their dreams or match the "pleasure-domes" of reality against those of the poet's fashioning. The writer, for one, must confess that he never expected to follow in the footsteps of Kublai Khan on the historic trail from Cambaluc to Ciandu or to stand amidst the ruins of that vast city which the Great Khan built as a summer palace—a marvel and a wonder to all beholders. The Europeans who have passed that way may be numbered on the fingers of both hands, and if one were to exclude those who have given no description of the city or its ruins the total would be still further reduced. Of these, the famous Marco Polo and Father John of Montecorvino and Friar Odoric of Pordenone journeyed to Shangtu, "the city of 108 temples," in the thirteenth century, while Dr. Bushell, of the British Legation in Peking, visited the site in 1872. The account given by the latter is confined to a brief report on the ruins which he found time to examine during his hunting trip in the vicinity,[1] while Odoric of Pordenone is even less explicit in his description, merely giving some account of the departure of the Khan and his retinue for the summer season at Shangtu.[2] As the bulk of the writings of John of Montecorvino appear

[1] S. W. Bushell: Notes of a Journey outside the Great Wall of China, *Proc. Royal Geogr. Soc.*, Vol. 18, 1873–74, pp. 149–167. C. W. Campbell, "Report on a Journey in Mongolia," *British Diplomatic and Consular Repts., China, No. 1, Cd. 1874*, 1904, visited Shangtu but merely says of it, "I have nothing of importance to add to Dr. Bushell's description."

[2] Sir Henry Yule, transl. and edit.: Cathay and the Way Thither, new edit., revised by Henri Cordier; Vol. 2: Odoric of Pordenone, *Hakluyt Soc. Publs.*, Ser. 2, Vol. 33, London, 1913.

Henri Cordier: Les voyages en Asie au XIV[e] siècle du bienheureux frère Odoric de Pordenone, *Recueil de Voyages et de Documents*, etc., Vol. 10, Paris, 1891.

to have been lost it is in the pages of Marco Polo[3] and the Asiatic historian Rashid-ud-din that our imaginations find satisfaction, for here only can one discover a pen picture whose vividness makes the dry bones of history live and take form. The writer will always remember the surprise and delight he experienced en route to Shangtu when, a day's march from that city, he saw three of the five sorts of cranes so graphically described by Ser Marco and realized that after all the scene had changed but very little since that spring day six hundred and fifty years ago, when the great Venetian traveler first sighted the towers of the imperial summer city. Step by step of the way from Peking, or ancient Cambaluc, the curtain of the years had been rolled back, until it was with a shock that one perceived the long ragged lines of ruined walls and crumpled masses of masonry where once the proud city of Ciandu had been.

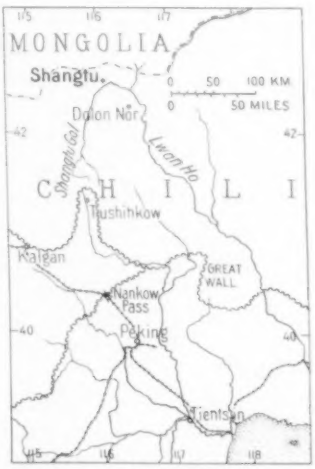

FIG. 1—The situation of Shangtu.

THE ROAD TO SHANGTU

As soon as the railway had been left behind for good and the baggage mules had begun that long ascent leading to the passes through the Great Wall at Tushihkow one had passed from the China of today into a China of everlasting years, in which the great eastern road to the Mongolian steppes followed its accustomed route of centuries even as when it had echoed to the passing of the hosts of the Great Khan himself. Up the valleys and through the passes winds the road, clearly defined in some places, obliterated in others, but always traceable by its succession of watchtowers. Countless thousands of footsteps have worn away the stones composing the original track, until in places where it crosses some range of hills by a defile the very rock is hollowed out for a couple of feet or more, so that the path of the pilgrim of yesteryear is become a veritable pitfall for the feet of the unwary traveler of today. All the way up, from the Nankow pass above Peking to the last miles of marshland that bring one into the ruins of Shangtu, one finds the watchtowers that guarded the trail for the great Khanate. Never more than five or six miles apart and nearly always so sited as to command a view of the valleys leading into the royal road, these towers are landmarks for miles round.

On the trail itself must have been the posthouses described by Marco Polo:

> habitations three or four miles distant one from another, where foot-posts live, having each of them his girdle hung full of shrill sounding bells. These keep themselves always ready,

[3] Sir Henry Yule, transl. and edit.: The Book of Ser Marco Polo the Venetian Concerning the Kingdoms and Marvels of the East, 3rd edit., revised by Henri Cordier, 2 Vols., London, 1903.

and as often as the Khan's letters are sent to them, convey them speedily to the next post, who hearing the sound of the foot-post coming when at a distance, expect him, and receive his letters, presently carrying them to the next watch, so that it often happens that the King by this means learns news, or receives new fruits, from a place ten days journey distant, in two days. As, for instance, fruits growing in Cambaluc in the morning, by the next day at night are at Ciandu. . . .

One can well picture the posthouses thus described lying in the valley beneath the shadow of the watchtower on the overhanging peak and surrounded by those mud huts and poorer sort of dwellings such as would serve for the housing and stabling of chance wayfarers, who would naturally tend to break their journeys near military protection in such a wild and forbidding country as is this. Even today there is a sense of insecurity as one travels up the pass to Tushihkow and the gate through the Great Wall, the hills towering and frowning down on either side of the trail, while the north wind whistles in the gorges till it seems as if the spirits of dead and forgotten robbers might well be in league with the bandits of today to waylay the weary traveler. That bandits have a real existence the writer had ocular proof, for he chanced to meet three Russians who had been attacked not five miles from a garrison town, one of these unfortunates having been shot through the head by a Mauser bullet.

To return to a consideration of the route followed, the point that most surprises one is the sudden change in the terrain almost immediately after the Great Wall at Tushihkow is passed, for as if by magic the frowning hills fall back on either side and gradually fade away to the horizon, yielding place to a land of undulating grassy plains, a natural ranching country, or so it appears at first sight. Here Chinese settlers from Shantung and Chihli have established their first farms, pushing on a few miles in every succeeding generation while the Mongols slowly retreat before them under the relentless pressure of economic superiority. That there are great possibilities here in spite of climatic disadvantages is evident from the many substantial buildings already erected by Chinese settlers and from the flocks of sheep, the herds of cattle, and the droves of horses amassed by them. For in this lies their principal wealth even now, that from simple agriculturists they have become horse and cattle breeders and dealers, buying from the Mongols their stock, feeding them up for a brief period, and then reselling to the great cities on the plains of China. Ever since the time of the great Khans the Mongol people have been retrogressing. After all, it must be recognized that even at the time of their greatest achievements, when their armies ranged almost unchecked from Peking in the east to Vienna on the west, their paramount position was due to military suzerainty over commercialized countries which contributed both their arts and their wealth to render memorable the rule of the Khanate. Bearing this in mind one is not surprised to find that the thrifty Chinese are steadily encroaching on the territories of the descendants of the great Kublai. What indeed can be the future of such a race as the Mongols, whose sole occupation is the pasturing of numerous herds of indifferent cattle and who

consider it beneath the dignity of a man to do even the slightest manual labor?

Not a village or a *yurt* in the Shangtu area shows signs of agricultural pursuits, in spite of the evident fertility of the soil, nor has any kind of vegetable or grain been grown there for generations. The writer was interested to see whether the great Kublai or his successors had made any endeavor to introduce agriculture here, either encouraged thereto by the advice of Marco Polo or John of Montecorvino or forced to it by the needs of such a city so far from the fertile fields of China. The fact that at some distant date there had been cultivation of the soil was attested by the formation of the ground in a sheltered spot in one of the southern-facing valleys of the surrounding hills, for plowed land leaves a peculiar swell and furrow that is almost unmistakable. In this case proof positive was forthcoming in the finding of a plowshare of iron so ancient that it was practically a mass of rust. It is interesting to speculate as to the source of the food supplies of this imperial city, for, if compared with other cities of China of the time, its very area taken with its suburbs shows that it must have harbored close on two hundred thousand persons. Within two days' march of Shangtu were three other cities whose sites were noted by the writer *en passant*, he having no time to make of them any very close examination. Two of these cities were on the route from Peking to Shangtu, while the third was a day's march to the east, near the town now known as Lama Miao to the Chinese, as Dolon Nor to the Mongol. In formation all these sites appeared similar to that of the outer city of Shangtu, having an earth wall in some places roughly faced with stone, but they differed from the royal city in that they had no inner walls or indeed, so far as could be judged from a cursory examination, any buildings of great importance. It might be suggested that they were intended as garrison towns for forces protecting the capital from sudden attack; and this seems reasonable, though it must

FIG. 2—En route to the Great Wall. Down this valley runs the road followed by the Khanate when visiting Shangtu. This and the following photographs are by Mr. Lawrence Mead.

be admitted that in this case one would expect to find a similar post on the Urga trail. Possibly, however, the watchtowers and the outer zone of earthworks were considered to be adequate protection on that side, there being no site for many miles where water was available.

The city of Shangtu itself must have been a marvelous sight to the eyes of the few Europeans privileged to visit it. Its position in the central plain encircled by beacon-crowned hills must have served to throw the numerous palace buildings and its reported 108 temples into high relief against the surrounding greenery. The usual approach from Tushihkow led up the valley of the Shangtu Gol (or River), and John of Montecorvino notes that before one reached the city one passed numerous buildings which might quite conceivably have served as barracks. The sites lie just to the south of Beacon 1 and a little outside the first line of earthworks, and, as they take the form of a large walled rectangle with numerous small buildings within, all facing onto a central plaza, it is reasonable to suppose that this was in fact a barracks where Kublai Khan quartered some of the numerous soldiery with which he always traveled. In this connection it may not be out of place to quote the picturesque description given by the worthy Friar Odoric of Pordenone of Kublai's journeying from winter to summer capital.

> Now this lord passeth the summer at a certain place which is called Sandu, situated towards the north, and the coolest habitation in the world. But in the winter season he abideth in Cambalech. And when he will ride from the one place to the other this is the order thereof. He hath four armies of horsemen, one of which goeth a day's march in front of him, one at each side, and one a day's march in the rear, so that he goeth always, as it were, in the middle of a cross. And marching thus, each army hath its route laid down for it day by day, and findeth at its halts all necessary provender. The king travelleth in a two-wheeled carriage, in which is formed a very goodly chamber, all of lign-aloes and gold, and covered over with great and fine skins, and set with many precious stones. And the carriage is drawn by four elephants, well broken in and harnessed, and also by four splendid horses, richly caparisoned. And alongside go four barons, who are called Cuthe, keeping watch and ward over the chariot that no hurt come to the king. And none may dare to approach within a stones throw of the carriage, unless those whose duty brings them there. And thus it is that the king travelleth.

Outskirts of the City

Turning again to our examination of the city we find that to the north of it and within the earthworks there is a similar site on a larger scale, and the layout inclines one to the belief that it was possibly intended for the use of cavalry, of which the Khan had a force far in excess of that of his infantry.

Passing inside the earthworks near the southwestern corner the traveler of today follows the causeway of banked earth constructed by the architects of the original city, of which fairly distinct traces still remain, leading on a diagonal to the west gate of the Outer City (Fig. 5). With regard to the earthworks just referred to, the writer would not care to give a definite

FIG. 3

FIG. 4

FIG. 3—Watchtower built by the Great Khan to guard the road to Shangtu: in the background runs the line of the Great Wall.

FIG. 4—A curious building erected by the Khanate on their route near the town of Pingting Obo. The architecture is reminiscent of that to be seen in Tashkent or Samarkand where the Khan Kublai also held sway.

opinion as to their intended use, in spite of a very careful examination, for it appears to him that they might equally well have served for purposes of defense or as boundaries to the hunting park which, according to Marco Polo, the Khan had constructed. It is true that Ser Marco seems to locate the park within the city walls themselves, but an examination of the city shows that its buildings would permit such use only in the northern portion of the Outer City, as indicated on the accompanying map. The writer therefore ventures the suggestion that a deer park may have been located to the north of the city proper but within the earthworks.

The earthworks commence on the west at the river (almost directly south of Beacon 1) and almost parallel the city wall in a northerly direction, though their course is somewhat zigzag. At one point they are pierced by what appears to be the intake for the water supply to the city moat, this apparently coming from the river at a point some distance to the south, that is nearer its source. In order that the water might flow as far as the city moat it would seem that the river must have been at a considerably higher level formerly, which may account for the construction of a causeway. Certainly the fifty-foot stream that is now the Shangtu Gol would neither supply a moat nor threaten to submerge a road. It is possible that this canalized supply had its origin in the vicinity of the ruined city shown on the map some twelve or thirteen miles to the southwest, though the writer is of the opinion that the moat was also filled by additional flood waters coming from the hills to the north of the city of Shangtu.

The valley leading to the northwest (between Beacons 3 and 4) was evidently the most important exit from the plain of Shangtu. It is barred by a dead straight line of earthworks running from the toe of one hill to the toe of the other, some stone facing being still noticeable in places. Presumably this valley leads to the Urga trail and was used by the Khanate forces coming and going on the Karakorum road; it is evidently also a route lending itself to enemy attack on the part of the nomad tribes from the north and west, their bandit activities being a recurrent source of annoyance to the weaker Khanate rulers who succeeded Kublai Khan. Passing eastward from the entrance to the valley one finds a break in the earthen line where is the dried-up site of a lake which probably contains some four or five feet of water after the rainy season in July and August. The writer's theory is that either this lake was formerly of much greater importance, or else its waters were penned up for a time and released into the city moat only during the three months of the year when the Khan was in residence; for at a point just outside the northeast gate there is a division in the direction of the moat which seems to show that it had here a dual source of water supply, the ground level being too high to permit of an intake from the river. The earthworks recommence on the far side of the lake referred to and make a sweep to the southeast, running thence towards the river. Presumably they joined it at one time in a manner similar to that on the west side of the city, but the marshy nature of the ground has engulfed all traces of

the work. It is worth noting that just outside the east gate of the city, and following northward within the earthworks as far as the toe of Beacon 12, is what must have been a very considerable suburb, some traces of which appear to extend to the south, as well, until the ruins are hidden in the marsh and reeds. To the south of the city the writer did not find any defense works whatever; though it is possible that some existed, they could not have been very important to have been thus obliterated.

The City Proper: Outer Walls

Turning from a consideration of the exterior works to an examination of the city of Shangtu proper (see Fig. 6), it appears that the outer walls are between 2300 and 2400 yards in length, with a compass bearing of 184 to 184½ degrees. Thus they deviate slightly from true north and south, supposing the compass to have been entirely accurate. It would appear to the writer that the site of Shangtu was occupied by a city before the time of Kublai Khan, who is recorded as being its builder, for the outer walls from Station 1 to Station 9, from Station 9 to Station 8, and from Station 8 to Station 7 are of different composition from the rest, being of earth only, with a core of stone showing at a point between Station 1 and Station 2. It is difficult to be certain as to this, for the Great Khan did undoubtedly improve and strengthen these walls if they were of a previous date, the gates and moat, from their similarity to the remainder of the fortifications, being almost certainly of his design. This theory of the reconstruction of the city is borne out by the account of it given by the historian Rashid-ud-din, A. D. 1247, who says:

> On the eastern side of the city (i.e. Kaimingfu, afterwards called Shangtu) a karsi or palace was built called Langtin, after a plan which the Khan had seen in a dream and retained in his memory. The philosophers and architects being consulted gave their advice as to the building of this other palace. They all agreed that the best site for it was a certain lake encompassed with meadows near the city of Kaimingfu, but for this it was necessary to provide a dry foundation. Now there is a kind of stone found in that country which is used instead of firewood, so they collected a great quantity of that stone and likewise of wood, and filled up the lake and its springs with a mass of bricks and lime well shaken up together, running over the whole a quantity of melted tin and lead. The platform so formed was as high as a man. The water that was thus imprisoned in the bowels of the earth in the course of time forced outlets in sundry places, and thus fountains were produced. On the foundation formed as has been described a palace in the Chinese taste was erected, and enclosed by a marble wall. From this wall starts an outer fence of wood which surrounds the park, to prevent any one from entering, and to preserve the game. Inside the city itself a second palace was built, about a bowshot from the first; but the Khan generally takes up his residence in the palace outside the town.

To return to our exploration of the site, it may be noted that there is now no sign of a moat on the south side of the city, probably owing to the marshy nature of the soil and the proximity of the river; but all along the west side and for some distance along the north wall it is remarkably clearly defined. It is somewhat difficult to determine the exact thickness of the

walls owing to erosion and collapse, but a fair estimate can be formed from an examination of the attached cross sections taken at different points along them. It must be remembered that the whole site of the city has

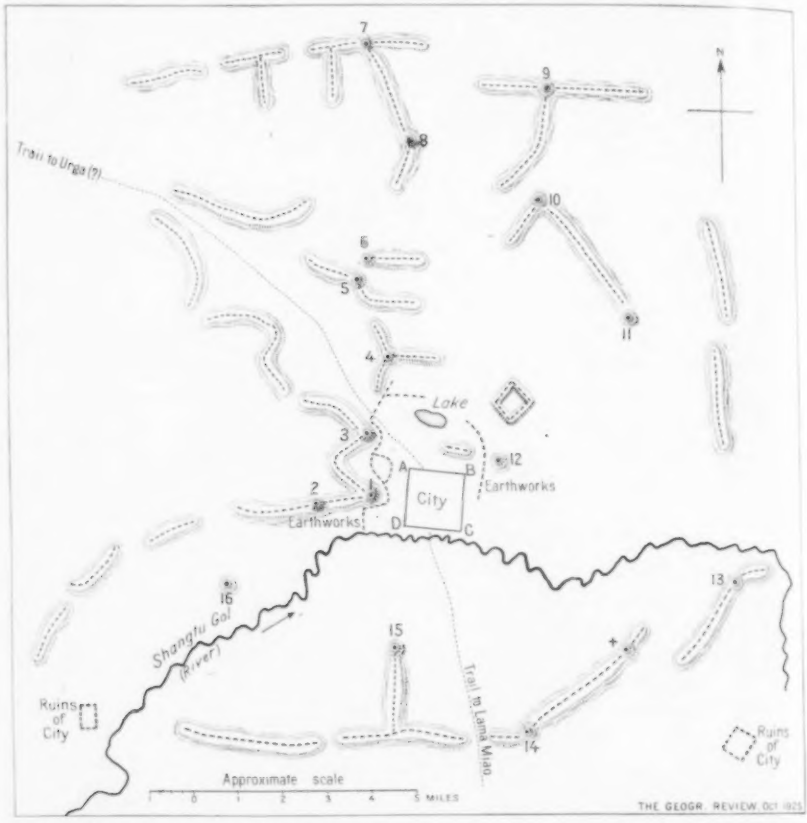

FIG. 5—Map of Shangtu region showing hills and watchtowers plotted by compass bearings, rivers sketched in approximately.

Compass readings are: From Station 12-B, 249; C, 208; 1, 257; 2, 257½; 3, 282; 4, 314; 5, 322½; 6, 327½; 7, 343; 8, 345; 9, 7½; 10, 10; 11, 43½; 13, 118½; X, 146; 14, 174½; 15, 210. Station 6-A, 169; B, 155; 1, 180; 2, 193; 3, 181; 4, 168½; 5, 213; 7, 360; 8, 19½; 9, 46½; 10, 71½; 11, 103; 12, 147½; 15, 177½. Station 3-A, 128½; B, 111; C, 157½; 1, 175; 2, 217; 4, 14; 5, 355; 6, 359; 7, 8½; 8, 53½; 12, 101; 13, 112; 14, 152; 15, 173; 16, 224. Station 2-16, 229; 1, 79½; 3, 37½; 4, 26½; 5, 10½; 6, 12½; 11, 59½; 12, 77; 13, 100½; X, 115; 14, 138; 15, 152. The readings were taken with a compass not checked for variation, and some allowance should be made for vibration caused by wind on the hill crests. The city walls are 4½ to 5 degrees from north, so that there may be some variation in compass and some error in the ancient methods used by the architect.

undoubtedly silted up to a considerable depth during the last five hundred years. The writer would imagine that there is at least five feet of top soil which has drifted in and more than that in the moats. It is obvious, therefore, that measurements of the actual wall footings were impossible in most places without preliminary excavation, for which there was neither time nor money.

Beginning with the earthen wall of the outer city at Station 2, the first point noticeable is the stone core of the earthwork, measuring 3 feet 10 inches in width, a core which is not traceable at some of the other points

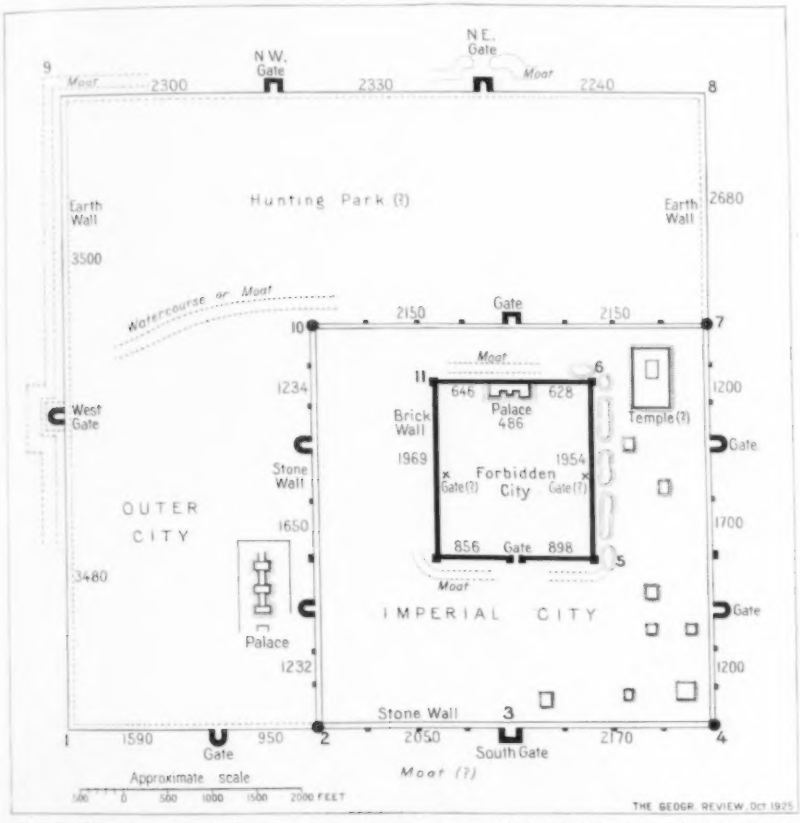

FIG. 6—Map of the City of Shangtu. The measurements were taken with linen tape and checked twice. A moat possibly existed to the south, but if so it has been obliterated by swamps in the vicinity of the river.

where time has eroded the surface of the wall. The gateway measures approximately 195 feet in width and 196 feet in depth, the height averaging 12 feet; its shape was semicircular, and it was faced with rough stone. As far as can be ascertained, the exit was towards the south; but this is difficult to determine without excavation owing to the collapse of the stone facing and the accumulation of débris under what must have been the arch of the gate. At Station 1 there was a tower of circular form, judging from the stonework remains and the higher elevation of the wall at this point and also from the fact that there are similar and more distinct remains at the southeastern extremity of the wall at Station 4; although, as this was a stone wall in any case, nothing decisive can be proved.

The gate on the west wall is of a similar type to the one just described on the south, being faced with stone and semicircular in form; but in addition it has a curtain measuring 90 by 267 feet projecting to the moat 14 feet away. The approximate dimensions of the gate are 211 feet in width and 223 feet in depth; the exit must have been to the west, for there are indications that a bridge existed here across the moat from the approach causeway. At this point the line of outer earthworks most nearly approaches the city, being only about four hundred yards away and very clearly defined; while from this gate to the northwest corner of the outer city the moat is most plainly marked also. Just beyond the angle the present depth of the moat is 9 feet 6 inches while its width is 132 feet, to which one may add probably another 7 to 10 feet for driftage. It is possible that there was stone facing at least on some part of its surface; but there are now no traces remaining.

Turning east along the north wall there is nothing of note until one comes to the northwest gate, which, judging from its size and the fallen stones which mark its site, appears to have been one of the most important exits from the city. This importance is probably due to the fact that the main trail from Shangtu leads, as before remarked, up the valley to the northwest. The gate is rectangular both within and without and measures 222 feet in width and 220 feet in depth, being faced with stone. Between this gate and the next there is now a large gap in the wall, apparently used as the exit of a main trail from Lama Miao to the northwest valley and probably to Urga, a city of comparatively recent interest. The northeastern gate, judging from its construction and the comparative absence of stone work, was not so important in its functions. Its shape varies slightly, being rectangular outside and apparently semicircular inside; its width is 200 feet and its depth 216 feet.

It seems probable that the northern gates were the exits to sites of interment, for at some little distance there are several structures that resemble Chinese cemeteries in their plan, with what are apparently sacrificial altars en route and at the grave sites. While discussing this point of sepulture the writer may instance the curious workings of chance, for during a whole month of research and measurements in the city and its vicinity he did not discover a single location that perfectly satisfied him as being a cemetery, though it was obvious that the inhabitants of the city must have been buried somewhere near, it being manifestly impossible for them all to have been transported to Peking or to their ancestral tombs in the Altai Mountains. The problem was eventually solved by an elusive antelope, in pursuit of which the writer penetrated to a considerable distance the range of hills to the south of the river. Here in a secluded valley he stumbled on a group of ruins that could be nothing else than graves, for there was neither water supply nor encircling walls to denote the existence of a town. Here doubtless sleep some of the worthy citizens and magistrates of Shangtu whom Marco Polo knew and admired. In passing it may be noted that one stone

which the writer examined in the ruins of Shangtu had a rough cross on the reverse side. Though this single fact by no means proves its Christian origin, one may imagine that here, perhaps, is a record of a convert of worthy John of Montecorvino, the stone itself perchance serving to mark the grave of some long-forgotten citizen of Shangtu.

Returning to the examination of the city wall, one passes without remark from the northeastern gate to the corner of the city, this point being the

FIG. 7.—The famous "devil dance" at Dolon Nor (Lama Miao), which very few foreigners are privileged to behold. This takes place in July, and Mongols come in thousands to see it.

highest elevation on the wall line. From here there is no visible trace of any extension of the moat down the eastern side of the city. Just to the north of Station 7 is a gap through which passes the Lama Miao-Urga trail. At Station 7 itself the Outer City wall joins the Imperial City wall and thenceforward is faced with stone. This spot is marked by the débris of what appears to have been a circular tower, measurement of which shows the base diameter to have been approximately 74 feet. The facing is of stone, and one would suppose that the batter would have been the same as that of the still existent tower at Station 10, namely one in five. The measurements of the wall just to the south of Station 7 were taken at a height of 14 feet from the ground and approximately 20 feet above the former footings, showing a width of 25 feet and a batter of one in four. Just below this there occurs the first bastion, which is rectangular in shape, measuring 35 feet in width and 21 feet in depth, the batter being nearly the same as that of the wall.

It is interesting to note this use of rectangular bastions in the East, such a construction having been first seen in Europe, as far as the writer is aware, in the beginning of the thirteenth century. One may speculate as to whether the design came from a common source such as Constantinople or some other

city of the Middle East, whether the idea originated spontaneously and simultaneously, or whether Marco Polo or his father taught the engineers of the Great Khan this art of military fortification. On the eastern wall there are two of these bastions spaced between each of the gates and the corner turrets, and they correspond almost exactly with those on the western wall of the Imperial City, the dimensions in all cases being presumably the same, though only three of them are in a sufficiently good state of preservation to permit of accurate measurements.

The first gate on the eastern side of the city is 196 feet in width and 203 feet in depth and was semicircular in form, the exit, as far as one can judge without excavation, being to the east. Passing south it is worth noting that the second bastion, which is the one next to the southeastern gate and opposite the southwest corner tower of the Forbidden City, is considerably larger than its fellows, though the broken nature of its débris renders measurements difficult. A similar bastion is to be found exactly opposite it on the western wall of the Imperial City, and this is in a better state of preservation, measuring approximately 48 feet in width and 32 feet in depth. On top of the western structure there seems to have been a smaller turret of rectangular form about 14 feet by 12, the height above present ground level being 18 feet; and it is reasonable to suppose that this construction was followed out in the eastern bastion also. The second gate on the eastern wall measures 188 feet in width and 200 feet in depth and, like the first, was faced with stone and was semicircular in form. The two bastions to the south of this are now only mounds of débris and present nothing of particular interest, while the circular tower at the southeastern extremity of the wall is similar to the one at Station 7.

The wall dimensions on the south taken at a height of 13 feet above the present ground level show 23 feet in width with a batter of one in three and a half. There is a ramp at Station 4 measuring 12 feet in width and 36 feet in depth, giving access to the wall on its southern side from the interior angle. There are three bastions between this point and the main south gate, which appears to have been intended to occupy a central position in the city wall and which is perhaps the most clearly defined and strongest of them all, measuring 193 feet in width and 211 feet in depth and being faced with heavy masonry. The form is rectangular. Three more bastion ruins carry the wall along to Station 2, where it joins the earth wall of the Outer City again, the spot being crowned by the ruins of a turret similar to those at the other corners of the city previously examined.

Western and Northern Walls of the Imperial City

From Station 2 the masonry wall of the Imperial City turns northward and is clearly defined for some distance, there being, as on the eastern wall, two bastions before the first gate to the west is reached. This gate is in a state of good preservation, enabling one to measure the exit and the facing

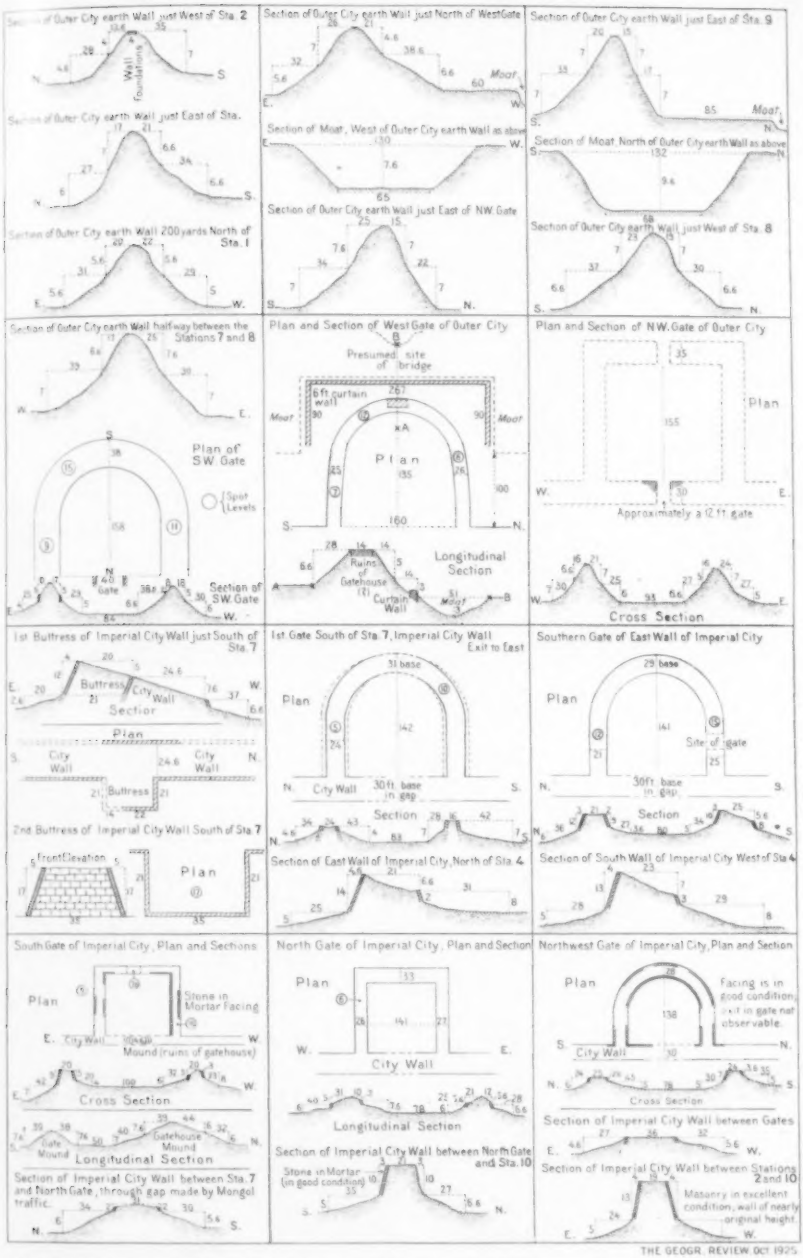
Section of Outer City earth Wall just West of Sta. 2
Section of Outer City earth Wall just North of West Gate
Section of Outer City earth Wall just East of Sta. 9
Wall foundations
Moat
Section of Outer City earth Wall just East of Sta.
Section of Moat, West of Outer City earth Wall as above
Section of Moat North of Outer City earth Wall as above
Section of Outer City earth Wall 200 yards North of Sta. 1
Section of Outer City earth Wall just East of NW. Gate
Section of Outer City earth Wall just West of Sta. 8
Section of Outer City earth Wall halfway between the Stations 7 and 8
Plan and Section of West Gate of Outer City
Plan and Section of NW. Gate of Outer City
Presumed site of bridge
6 ft curtain wall
Plan of SW. Gate
Spot Levels
Plan
Longitudinal Section
Ruins of Gatehouse (?)
Curtain Wall
Approximately a 12 ft gate
Cross Section
Section of SW. Gate
1st Buttress of Imperial City Wall just South of Sta. 7
1st Gate South of Sta. 7, Imperial City Wall
Exit to East
Southern Gate of East Wall of Imperial City
Buttress
City Wall
Section
Plan
Site of gate
30 ft base in gap
2nd Buttress of Imperial City Wall South of Sta. 7
Front Elevation
Section of East Wall of Imperial City, North of Sta. 4
Section of South Wall of Imperial City West of Sta. 4
South Gate of Imperial City, Plan and Sections
North Gate of Imperial City, Plan and Section
Northwest Gate of Imperial City, Plan and Section
Stone in Mortar Facing
Mound (ruins of gatehouse)
Cross Section
Gate Mound
Gatehouse Mound
Longitudinal Section
Facing is in good condition, exit in gate not observable.
Section of Imperial City Wall between Gates
Section of Imperial City Wall between Sta. 7 and North Gate, through gap made by Mongol traffic.
Section of Imperial City Wall between North Gate and Sta. 10
Section of Imperial City Wall between Stations 2 and 10
Stone in Mortar (in good condition)
Masonry in excellent condition, wall of nearly original height
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FIG. 8—Typical plans and sections of the ruins of Shangtu. For locations see Figure 6. Relation between the horizontal and vertical scale varies, in most cases the vertical being exaggerated two or four times. Figures in feet.

of the interior and exterior walls, the width of it being 193 feet and the depth 204 feet, while the stone facing has a batter of one in five and an average height of 14 feet. It is uncertain whether a wall existed here before the construction of Kublai Khan's city; if the previous city was walled, one would suppose there would be gates facing the reverse way, though it is possible that Kublai simply used the old material and shifted the gates to face the other way, adding a stone casing to the previous earth wall. This theory is to some extent substantiated by the curious construction of the next gate,

FIG. 9—The passage through the Great Wall at Tushihkow. The wall is seen running across the valley on the right. A temple dedicated to travelers is just within the gate amongst the trees.

which had no exit traceable and appears to have been a dummy gate built to render the city plan uniform.

The western wall measurements taken at a height of 5 feet above present ground level show a width of 36 feet, while those taken at a height of 18 feet give a width of 19 feet, so that if one estimates the depth to the actual footings as being another 6 feet it would seem that the base of the wall should approximate to 40 feet, while the top measurement after allowing for erosion would be about 16 feet. The corner turret at Station 10 is the best preserved of the four, the diameter being approximately 75 feet and the height 27 feet. It appears that there was a small rectangular building on the summit, faint traces of which are still observable as a building line; in the débris the writer found fused and twisted bits of metal, evidently relics of the fire with which the Chinese destroyed the whole city on its capture from the last of the Khanate. The width of the wall is 35 feet at ground level at this point, and thence a succession of three bastions carry the line along eastward to the northern gate of the Imperial City, this gate being immediately behind what appears to have been the site of the Imperial Palace in the Forbidden City. The gate is rectangular in form, like its counterpart to the south of the city, while the measurements show a width of 194 feet and a depth of 214 feet, with an exit to the north. The northern wall measurement taken at a point 15 feet above present ground

level gives a width of 22 feet, and the line seems to be much the same for the remainder of the distance to Station 7, there being the balancing three bastions between the north gate and that point.

Walls of the Forbidden City

Leaving the wall of the Imperial City one turns next to that of the Forbidden City, which appears to have contained far more brick and less stone

Fig. 10—A typical scene across the Mongolian plain with its setting of low hills. The village is crowded with Mongols and Chinese who have come from far and near to see a traveling theatrical company.

and to have been more nearly perpendicular, the foot, judging from the traces still remaining, having been protected by a moat for its whole circumference. Beginning at Station 6 it is to be noticed that the circular form of corner turret has been abandoned in favor of a rectangular one, as is plainly indicated by the wall foundations shown in hatched line on the large-scale plan. These remains give the general line quite plainly, and the theory of design is further proved by the measurements taken on the southwestern corner of the Forbidden City, where the outline of the turret is even more clearly defined. Unfortunately it seems that generations of lamas from the near-by temple have made a practice of obtaining building material thence and from the adjacent wall, with the result that the surface layer has in many places been removed, though the second or third course is still *in situ* for considerable distances.

The Forbidden City itself is rectangular, measuring approximately 1750 feet east and west by 1960 feet north and south. The wall dimensions taken at various points give a width of 20 feet at 11 feet above present ground level; but a better idea of its contour can be obtained from an examination of the accompanying sections. In the eastern wall of the city there is a considerable gap, shown in Figure 11, where it is possible there existed a gate in former times. Marco Polo makes no mention of it, but Dr. Bushell recorded it when he visited the city in 1872, stating that there were both

eastern and western gates, and a southern gate in a good state of repair. The arch of the southern gate has now collapsed, but its remains are clearly defined and easily measurable, so that one is all the more inclined to regret that all traces of the eastern and western gates referred to by Dr. Bushell have disappeared. The south gate of the city, which is not quite centrally located, had a 10-foot arch according to Dr. Bushell, the present width being about 12 feet and the depth 49 feet. The masonry facing projects beyond the wall line both within and without, the first return occurring some 7 feet from the gate entrance and the second return another 26 feet farther on.

The remainder of the city wall is similar to that already described until the northwest corner is reached, where the original facing exists for considerable distances along both sides of Station 11. When the northern wall joins the back of the King's Palace site it is almost perpendicular, and the facing of the Palace mound projects several feet from the regular line. Here again it is difficult to determine the exact nature of the juncture because of the removal of material. It is interesting to note that much of the wall structure here and elsewhere contains tile of a plain blue or green coloring, seeming to indicate that the Great Khan had his kilns on the site and that the throw-outs not used for roofing were dumped into the wall work. The dimensions of the wall on the north side of the city taken at a point 16 feet above present ground level shows a width of approximately 20 feet, the stone facing being set in rough mortar with drainage gullies in the face at various points.

Sites in the Forbidden City

We now turn to a consideration of the various sites (see Fig. 11) in the Forbidden City, which were carefully examined by the writer for any surface indications of building construction, carvings, pottery, etc.

A. Central building indistinct; practically no tiles; those discovered, plain. Built on two levels, main site on 3-foot terrace, the forecourt being 1 foot above surrounding ground level. Two side rooms on forecourt, indistinct. Site contains mixture of blue or gray brick and stone. Surrounding wall to whole site, which showed no china or pottery.

B. Central building similar to A but plainer; stone walls; not much brick on site. Plain tiles and few pieces of red baked tile with green facing. Three rooms on left of forecourt on entering, possibly one on right also. Surrounding wall of stone 3 feet thick. Central block 2 feet above forecourt, which is 2 feet above surrounding ground. Few pieces of coarse pottery and china on site.

C. Building of considerable importance immediately to northwest of gate mentioned by Dr. Bushell, which presumably occupied part of present 60-foot gap. Outer wall of stone; minor buildings outside and to the right on entering, apparently of small importance. Forecourt has two courts at sides and leads to massive gate with gatehouse on either side, dividing wall being 3 feet thick. Gray brick and stone on site, together with some green tile. Inner court same width as the outer one; irregular building on left; courtyards, or walled-in spaces, on right and left continue nearly the whole length of the site. Main building rises 1 foot above court level and has mass of rubble choking the back of it, with some bits of marble and of blue and green tile on the site. Back of this building are curiously distorted mounds of rubble 3 feet high. Small buildings to left rear of block are continued externally to main wall. Apparently rear entrance to main block also. Depres-

sion to right of main building may have been small pond. Well sited outside west wall. Very little china, but carved finials and carved bricks were found on site.

D. Stone outer wall. Forecourt has two courts opening on it, one on left with small buildings, three rooms also on right. Ground rises to inner court about 2½ feet, terraced with rooms right and left. Central building rises another foot and has 2½-foot brick walls. No china visible, but broken green tiles; also yellow and blue moldings, all on red baking. Ground falls sharply at rear to surrounding wall. One piece of good china found outside wall.

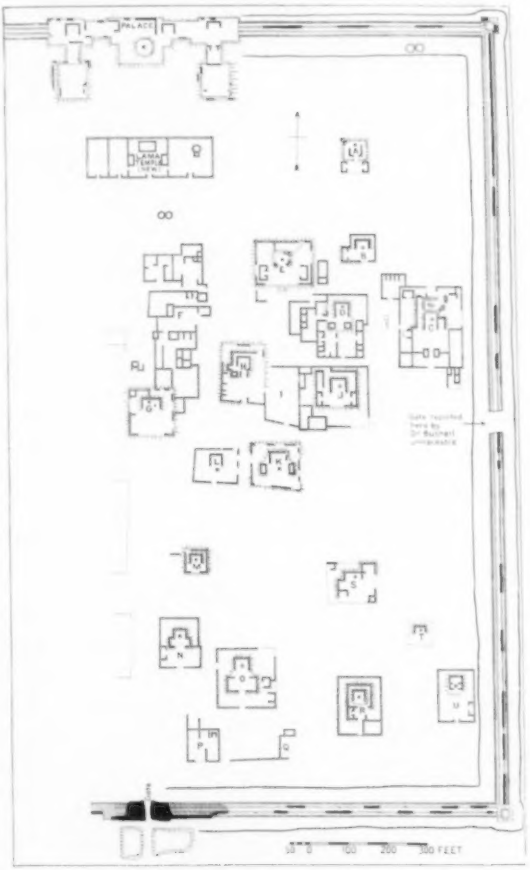

FIG. 11—The eastern half of Shangtu, Forbidden City (cf. Figure 6).

E. Few unimportant rooms on the right of approach; main site has high bank all round; wall apparently at top. First rise 5½ feet; steps, if any, not visible. Small buildings to right and left of forecourt. Central building usual open type facing south. The side and rear walls have been partly excavated, probably to enable lamas to obtain brick. No tiles or china found.

F. An irregular group of small buildings on the approach, along center line of Forbidden City; no distinguishing features. No tiles found, but some china. Ground only slightly above surrounding level.

G. This building appears to lie on the junction of roads connecting the gates of the Forbidden City. Site has banking about 5½ feet high, with wall on top. Small building to left rear of main block, which has deep depression in front and slightly to left of it. No tiles or china found.

H. Surrounding wall of stone; large forecourt with buildings to right and left of approach to main block, which is 4 feet above surrounding ground. Surface of site very irregular, and back wall of main block partially excavated. Plain and blue tiles found on site.

I. Practically nothing to be seen; may have belonged to either H or J as a garden.

J. Surrounding wall very indistinct to south, apparently had gatehouse. Buildings in forecourt are mainly on west, continuing round to rear of main block. This has a central approach somewhat indistinct and has small rooms to left and right of inner courtyard. The main block looks as if it had two rooms, one with a north entrance, as there is a gap in the inner and outer surrounding walls at this point and a central mound of débris to the

main block. No tiles or china noticeable, but one very large column base to east rear of site. Inner court raised 2 feet, main building another 2 feet higher.

K. Outlines faint; site irregular, 2 feet above ground level, with earth and rubble mounds. Some green tile, considerable gray brick, but no pottery or china.

L. Surrounding wall distinct, but inside only main block visible; almost on outside ground level. Either subsided or not important building. No tiles or china.

M. High mound with wall at slope top, possibly also outer wall not now visible. Site occupied by main block only; some plain tile, some pottery and china. The inner court 3 feet above ground, main block another foot higher. Some large gray bricks on site.

N. Surrounding wall very distinct, with central gate on south. Buildings to left and right of forecourt. Slope up to central block; inner court has small building on right and left. Main block in gray brick, has depression in center. No tiles, pottery, or china visible.

O. Surrounding wall distinct; buildings to east of outer court. Inner court bigger than usual; also has buildings to east and west. Each rise from outer to inner court and to main block about 1½ feet. Piece of gray molding in main block; no china or pottery.

P. Gate to south not central. Main block irregular and covers the rear of site, chief débris being towards the northeast corner, about 2 feet above ground level. No china or tiles; not much brick.

Q. Negligible.

R. Main wall distinct. Buildings in outer court to east, apparently with a surrounding wall. Inner court buildings on west; the surrounding wall continues round main block all the way. Main block of gray brick; some molding on site, also plain tile and china. Depression in center of site; height about 5½ feet above level of outer court.

S. Wall indistinct; building on west of mound and also on center and northeast corner. Ground rises 3 feet, some big slabs of stone on east side of site.

T. Central block only visible; surrounding wall probably submerged, as this land is marshy.

U. Surrounding wall distinct; courtyard has building on east of entrance. Main block about 3 feet above outer court. Stone walls mostly; piece of gray molding and piece of marble on site.

The King's Palace

It may be contended that the writer has taken a liberty in naming the most important site in the Forbidden City. It is because of its importance that he has designated it the "King's Palace." Furthermore, we have the statement of Marco Polo, who tells us that the Khan "erected therein a marvelous palace of marble and other stones, which extends to the wall on one side, and the middle of the city on the other." The site is formed of rammed earth and comprises a central block and two wings, as shown in the plan. It must originally have been faced with brick, for some of this work still remains in situ, being laid in hard mortar. On examining the face of the mound the writer noticed some circular openings which were tenanted by rock pigeons and which he at first presumed to have been made by them. A closer examination, however, revealed that these holes, which are about six to eight feet apart and six or seven feet below the top level of the mound, ran back for a considerable distance into the block. With the aid of a light and a stick the writer found that in several of them were the remains of what seemed to be cedar poles some six inches in diameter, these having dried to the consistency of tinder. Unless they were intended as support to a balcony of some kind the writer is unable to conjecture what could

have been their use. Not that such a construction is usually known in China, but it seems improbable that the poles, which are of a wood not found in northern China, would have been brought thither for an unimportant portion of the building.

The three main blocks of the Palace appear to have been roofed with different colored tiles, for blue, green, and imperial yellow were found on the different sites. A paved yard lay in front of each, and from the fact that the writer found several large pillar bases he would imagine that there was some form of veranda such as is common in the palaces in Peking. It would be interesting to know if there were any dungeons or cellars in the building, for at the present time there are three caves or cellars with arched roofs in the main block base. As far as is known, such a form of architecture was not in use, and the caves may have been excavated since; but, on the other hand, there seems no good reason why they should have been, for not only are they not very habitable but the Mongols always live in *yurts*, while the site of the city, with the exception of the location there of one lamasery, presumably intended to ward off the wandering of the ghosts of the dead, has not been used by them for hundreds of years.

Two other buildings of importance were discovered by the writer in his search for the possible site of another royal palace. Rasr'deddin tells us in his account of the city that the Khan had "another palace in the outer city to the west, of which he was very fond"; and, after examination of all the building sites of importance there, the writer decided in favor of the one shown, which has the largest area and the most massive surrounding wall of all sites in the whole city. All over the surface are to be found bits of broken pottery and china in extraordinary profusion, though unfortunately they are in such small fragments as to have no practical value. The same may be said of all the pieces found in the city, their number being legion; and the writer is of the opinion that they have come to the surface from the action of the thousands of moles working underground and casting out of their tunnels the bits small enough to be moved. If this theory is correct, and there seems no other to fit the circumstances, there must be a treasure of pottery and bronze lying there underground, awaiting only the spade of the scientific excavator. The other site in the northeast corner of the Imperial City shows the same indications to a lesser degree, and the writer would incline to the belief that it is probably a big temple. To the rear of the main building he discovered a stone turtle below the surface of the ground, with the usual slotted back for holding an inscribed tablet; but, unfortunately, the superstitions of the Mongols would not allow him to excavate in the vicinity at that time.

The Treasure Awaiting Excavation

There is no doubt a rich reward awaiting the excavators who can finally overcome the opposition of the natives, either by reasoning or by presents;

for of all the wonders of the city founded by Kublai Khan not a tithe can have been carried away by the Chinese army that finally destroyed the place and overthrew the suzerainty of the Mongols. This is plain from the nature of the struggle, for the Chinese force that pursued the last of the Khans from Peking to Shangtu was mainly infantry; and infantry would loot only such articles as were portable, leaving stones and bronzes alone as being both too heavy and too valueless for transportation. How much of the priceless records which must have existed in the city at that time were destroyed by fire it is difficult to say; but the writer conjectures that, as the walls and roofs were of stone and tile, the fire would be limited, while the collapse of the buildings would cover the contents and protect them to some extent against the ravages of weather and time. If one recalls the recent discoveries of the Russian scientist and explorer Khozlov in Karakorum, one may easily suppose that similar and even greater finds await the patient and enthusiastic seeker in the ruins of Shangtu, and it would be well worth the while of some museum to take up the quest at the point where the author was forced from want of time and money to relinquish it. Not only might this scheme of research be carried out, but explorations might be made eventually to include others of the lost cities of the Khanate, all of which undoubtedly contain valuable historical records.

THE NORSEMEN IN GREENLAND

RECENT DISCOVERIES AT HERJOLFSNES

By William Hovgaard

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It is well known that Icelanders settled in Greenland at the end of the tenth century and established two colonies, the Eastern Settlement, in the southernmost part of Greenland just west of Cape Farewell, and the Western Settlement, about 170 miles up the west coast, in latitude 64° N., at the place where the present colony of Godthaab is now located. Greenland was Christianized early in the eleventh century and in the middle of the twelfth century was brought within the archbishopric of Nidaros, the present Trondhjem. In 1261 the colony, after having existed as a free state for more than two hundred and fifty years, submitted to the crown of Norway, but Greenland had been dependent on Norway economically long before she became dependent politically. The commodities that were most needed, such as iron, timber, and grain, could not be supplied from Iceland; and by submitting to the King of Norway, to whom taxes were henceforth paid, there was a guarantee or probability of a fairly regular connection with Europe. Actually, the Norwegian shipping declined in the thirteenth century through Hanseatic competition; several other causes contributed to make the sailings of the King's ships, the so-called "Knörr," from Bergen to Greenland less frequent, and in 1410 they ceased. From that time on Greenland was, so to speak, a lost country; but its position had been recorded on the map of Claudius Clavus, and old sailing directions from Norway to Greenland were preserved in Icelandic manuscripts. In 1576 Greenland was rediscovered by Frobisher, and in 1721 the missionary Hans Egede arrived—the first European settler after the days of the Norse colony. It was hoped that remains of the Norse colony might still be in existence, but Egede found that it was extinct and that the land was inhabited entirely by Eskimos.

Much doubt has existed as to the ultimate fate of the Norsemen in Greenland. Some have assumed that the colony was exterminated by the Eskimos, and certain accounts in the sagas undoubtedly point in that direction; some have ascribed the disappearance of the Norsemen to a fusion with the more numerous Eskimo population. A third explanation has been offered according to which the colony slowly succumbed through deterioration of vitality. This explanation is confirmed, at least as regards the most southern part of Greenland, by the results of the excavations at Herjolfsnes by a Danish archeological expedition, the work of which is described in this article.

The following account is an abstract and in many parts an extract of three reports, respectively by the leader of the archeological expedition, Dr. Poul Nörlund, of the National Museum in Copenhagen; by Dr. Finnur Jónsson, professor of Norse philology in the University of Copenhagen; and by Dr. F. C. C. Hansen, professor of anatomy in the University of Copenhagen. These reports were made to the "Danish Commission in Charge of Geological and Geographical Survey of Greenland" and were published in *Meddelelser om Grönland*.[1] The facts they bring to light are of the greatest interest both from a historical and from a geographical point of view. The excavations lead to new and unexpected conclusions as regards the fate of this outpost of Western civilization, they yield an absolutely unique collection of original medieval costumes, and they point to important climatic changes in these regions. They also show that communication with the Norse colony continued to a much later date than hitherto supposed.

In the summer of 1921 the expedition under Dr. Nörlund went to Ikigait, where the Norsemen's Herjolfsnes was located and where it was known from former investigations that remains of a medieval Norse settlement existed. The object of the expedition was to examine the ruins, which comprised a church and farmhouses, but more especially to excavate the cemetery, in which coffins and skeletons in shrouds had been found.

Herjolfsnes was named after Herjolf Baardson, one of the followers of Eric the Red, who settled in Greenland in 985. It is situated at the mouth of the beautiful Herjolfsfjord, the present Narssarmiut, near Frederiksdal and not far west of Cape Farewell. Its significance was due to the fact that it was the port of call, or first landing place, in the difficult and dangerous navigation to Greenland. It is proper at this point to note that the Norsemen were the first to sail deliberately and repeatedly across the ocean. Down to that time, as far as known in history, alike in Europe, Africa, and Asia all long-distance navigation had been coastal; but the Norsemen crossed the sea first from Norway to Iceland, then from Iceland to Greenland, and finally directly from Norway to Greenland. This ocean navigation, which incidentally on at least one occasion extended to the American continent, became a regular institution, which lasted nearly four hundred years. Sailing directions were formulated, and experience was handed down from one expedition to the next.

The Excavations

The excavations covered the period from July 5 to August 27, 1921. They began with the ruins of the church and the farmhouses, which had been partly excavated at an earlier date. It was found that the church was

[1] Poul Nörlund: Buried Norsemen at Herjolfsnes: An Archaeological and Historical Study, *Meddelelser om Grönland*, Vol. 67, 1924, pp. 1–270.
Finnur Jónsson: Interpretation of the Runic Inscriptions from Herjolfsnes, *ibid.*, pp. 271–290.
F. C. C. Hansen: Anthropologia medico-historica antiquae I: Herjolfsnes, *ibid.*, pp. 291–547.

FIG. 1

FIG. 2

FIG. 1—Herjolfsfjord, the present Narssarmiut, west of Cape Farewell. This and the following illustrations are from photographs kindly loaned by Dr. Poul Nörlund, National Museum, Copenhagen.

FIG. 2—Herjolfsnes, now called Ikigait, where the excavations took place. The ruins of the church in the center of the picture.

built on the site of a still older church, and evidence of the burial ground belonging to the latter was found in a coffin, the head of which was covered by the foundations of the later structure. Decorations incised on the foot piece of this coffin indicated that the church could not have been built earlier than about 1150, and other evidence seemed to show that it was built about the year 1300.

The excavation of the cemetery was the most important and interesting part of the work. Altogether relics of 110–120 different burials were brought to light in spite of the fact that the southern part of the cemetery, where the richest finds would probably be located, had been washed away by the sea. Only the inferior northern part remained, and the shore line ran close below the south wall of the nave, which had already begun to collapse. The dead were either buried in wooden coffins or laid directly in the earth in the clothes they had worn in life. Probably coffins were used only for people of means, as wood was scarce and expensive. The bodies in the coffins were usually completely decomposed, while in the shrouds skeletal remains were often found.

Christian burial customs were scrupulously observed. The dead bodies were always placed with the head towards the west so that they might face the rising sun when they rose on the Day of Judgment. Great faith was evidently placed in the power of the cross, as shown by the small wooden crosses laid on the breast of the dead. It appears, however, that this custom gradually faded out, for in the later period of the colony crosses became more and more simple or were entirely absent, being symbolized by the crossing of the arms of the body.

The coffins were of extremely simple construction, consisting of a few boards assembled by treenails; the form was trapezoidal, narrow at the foot. A few of them were tied together with whalebone fibers in the way employed by the Eskimos, as was the case in the very early coffin found under the walls of the church. In many cases the lid of the coffin was missing or was crushed in; probably the coffins were often used a second time.

The costumes employed as shrouds were of woven material, generally a four-strand twill. The material was sheep's wool, and the thread was in most cases simply twisted, rarely spun of two yarns. No fur clothing was found, although it is known to have been used; but if used for shrouds it deteriorated completely, as might be expected. Many of the shrouds were threadbare and patched, showing great wear. Darning was apparently unknown.

Numerous examples of loom weights and other spinning and weaving implements, such as occur in the sites of all the old Greenland colonies, were found, testifying to the importance of this industry.

The principal part of the costume was a garment that was generally slipped over the head like a shirt, but some were open in front and provided with buttons. The slip-over dresses were made of two main pieces, a front piece and a back piece, joined by shoulder seams and by side gores. The

sleeves might be short or long. The men's dresses were slightly shorter than those of the women, but otherwise no difference could be detected. In general, sex could only be determined from the skeletal remains found with the costumes.

It is interesting that in none of the costumes from Herjolfsnes is it possible to detect a single special Greenlandic feature. There seems to have been no attempt at adaptation to the arctic climate or to the mountainous nature of the country, nor is there any trace of influence of Eskimo culture.

In cut and style the costumes were an imitation of the European fashions of the day or of a period slightly preceding it. The value of the costumes exhumed at Herjolfsnes is enhanced by the fact that practically no European dresses from that period are elsewhere in existence. As stated above, all the dresses were long; the fashion of a short dress for men, which began in Europe about the middle of the fourteenth century, did not reach Greenland. The style of most of the dresses belongs to the second half of the fourteenth century, but a certain number of fashions from the fifteenth century are also present. Probably there was communication with Europe throughout the fifteenth century, perhaps through Hanseatic or English traders, who intentionally or accidentally landed in Greenland on their voyages to Iceland for dried fish.

FIG. 3—On the left a woman's dress, about the year 1400; on the right, man's dress, fourteenth century.

The headdress was the common medieval hood, which incidentally was well suited to the severe Greenland climate. It was made to pull down over the head, fitted closely around the neck, and had a shorter or longer cape falling down over the shoulders. In front above the forehead it usually projected in a small "horn," because the edge was designed to be turned back from the face. Behind, it had a tail of varying length and breadth. Besides the numerous hoods there were found five round caps of simple cut, with round crown and deep rim, most of them cylindrical. One of the caps, however, was twice as high as the others and of conical shape and is of particular interest as an example of a style which did not appear in Europe until the fifteenth century. It appears, in fact, that this find is among the latest of the articles from Herjolfsnes, for it is unlikely that this fashion could have reached Greenland before the close of the fifteenth century. We have thus a fairly certain indication that intercourse with Europe was

not entirely broken off before that time, that is almost one hundred years later than commonly assumed.

The wooden crosses are also of great interest. Altogether 58 specimens were found, varying greatly in workmanship and design. The ornamentation is simple but always in good taste. On some of them runes are inscribed, often of superior workmanship, clear and accurate, carved with a knife or traced with a needle. The style of the early Middle Ages is predominant, but otherwise the runes give no clue as to date.

Some fragments of drinking and cooking vessels were found, mostly of soapstone. A fragment of a pitcher of Rhenish stoneware gives evidence by its design of communication with Europe in the fifteenth century.

FIG. 4—The characteristic medieval hood was well suited to the severe climate of Greenland.

The work of exhumation and conservation of the articles required the greatest care and skill. Most of the coffins were very fragile, and the costumes that lay directly in the earth were particularly delicate, being saturated with water and having recently thawed. It was decided that the best way to preserve the costumes and the wooden objects on the long voyage to Copenhagen was to pack them firmly in moss saturated with moisture. In this way the objects were kept damp without being excluded from air, and this method proved so successful that when they arrived in Copenhagen three months later they were found to be in exactly the same condition as when packed. The finds filled twelve large cases.

THE INSCRIPTIONS

The runic inscriptions were interpreted by Professor Finnur Jónsson. The most interesting was that found on a small wooden stick in one of the coffins, reading thus in translation: "This woman, whose name was Gudveg, was laid overboard in the Greenland Sea." Probably this stick was carved in her memory, placed in a coffin, and buried as representing the dead woman.

In 1830 a tombstone was found at Ikigait in an Eskimo hut over a door, where it formed the lintel. It bore the inscription, "Here rests Hroar Kolgrimsson," written in majuscules.

On one of the crosses was found the inscription in runes: "God the Almighty guard Gudleif well." Another cross bore the inscription, likewise in runic characters: "Torleif made this cross in praise and worship of God the Almighty." Several other inscriptions were found, some of them less clear.

The Skeletal Remains

The examination of the skeletal material made by Professor Hansen yielded most valuable information of the build, somatic complexion, life, and diseases of the Norse population of Greenland, information which supplemented that given in the sagas and which could hardly have been obtained in any other way. All skeletal remains, even such as were in a very poor condition, were anatomically examined in the most careful manner. The remains of 25 individuals were examined. The anatomical investigations showed a surprisingly good agreement with the archeological work of Dr. Nörlund as regards the determination of age and sex.

Of the 25 individuals there were 7 adult males, 10 adult females, 4 adults of undetermined sex, and 4 children of 11 to 16 years of age. Ten individuals were between 18 and 25 years of age; the preponderance of the young was striking.

Fig. 5—Carved wooden crosses laid on the breasts of the dead. The largest is about 12 inches in length.

It was found that the stature of the population of Herjolfsnes in later times was in general very short. The three greatest heights were between 5 feet and 5.3 feet, found among the men, while the height of all the women was less than 4¾ feet. Only the most powerfully built woman, who was kyphoscoliotic, could in normal condition have been close to 5 feet high. A conspicuously large number of the women were of slight and feeble build; they were narrow across the shoulders, narrow-chested, and in part narrow at the hips. Several showed symptoms of rachitis, deformity of the pelvis, scoliosis, and great differences in the strength and size of the right and left lower extremities.

From a study of the ages of individuals, already referred to, Professor Hansen infers that the death rate must have been very high, especially among the infants. Of all the individuals over eighteen to twenty years of age, that is four-fifths of the total material, one-half died before their growth was quite completed, i. e. before the thirtieth year, and of these one-fourth died before the twenty-fifth year. Of the individuals who died between the ages of eighteen and thirty years there were twice as many women as men, the cause of which must be sought in the dangers involved by pregnancy and parturition consequent on poor physical development, contraction of the pelvis, and other pathological conditions.

Of twenty-five individuals only five were fairly powerful or well-grown. Of the eight small or slender women five had blemishes or physical defects of various kinds.

The jaws and teeth were on the whole good and powerful although not very large. There were no signs of caries or of loss of teeth by scurvy, but

the teeth showed an abnormal amount of wear. Even in childhood and early youth some of the teeth were worn down to one-half or, in the case of early-cut teeth, even one-fourth of the height of the crown. Comparing their teeth with those of the Eskimos, who live on animal food, it becomes clear that the Norsemen in the later period must have subsisted chiefly on food of a very wearing nature, such as vegetable foods that required a great deal of trituration, probably certain edible lichens and seaweeds and the leaves and bark of certain trees, such as have been used all over the world in times of scarcity and especially in periods of starvation.

Not the least interesting part of Professor Hansen's work is his reconstruction of the profile of the face in the best-preserved male cranium from Ikigait, a process in which he has great experience and by which he had previously produced remarkable results. The elaborate method of anatomical reconstruction is fully described and illustrated, and the resulting profile is of a type well known in northern populations.

The general conclusion from the anatomical investigation is summarized by Professor Hansen as follows:

"The vigorous northern race that originally colonised Greenland degenerated in the course of the centuries under the influence of the hard and at last constantly deteriorating life conditions and other unfavourable conditions, especially isolation, both intellectually, materially and as regards race hygiene. It became a race of small people, little powerful, physically weakened, with many defects and pathologic conditions."

The degeneration in height is "a striking example of the well-known effect of chronic under-nourishment and hard conditions of life on a population, especially on the physical development and stature of the children and younger individuals, when the injurious influence extends to several generations."

"The deterioration of the climate, a higher death-rate among the farm animals, a decrease in the yield of hunting and fishing from several different causes (ice conditions), most probably also competition with the invading Eskimos, have *combined with the decline of the vitality of the population from other causes to form a circulus vitiosus finally involving the extinction of the Norse colonies*, . . ."

We shall here give verbatim the pathetic picture drawn by Professor Hansen of a young woman from Herjolfsnes; her probable appearance, her life, and the fate of her body after death. This description results from a scientific study of the skeleton numbered XX among the finds:

> The individual was probably a young woman, perhaps a servant or at any rate without means. She was small, at most 145 cm. of stature, perhaps somewhat shorter; rather narrow across the shoulders and chest and not broad at the hips, on the whole somewhat slenderly built and in her growing days had suffered from some rhachitis. Further, she was knock-kneed, which appeared plainly when she walked or ran. Her ankles were thick and clumsy. The right leg, though of the same length as the left, was somewhat thinner and feebler. In the left knee she had recently begun to get a little arthritis, and at times it hurt somewhat on the inside. Her head was small, the forehead low, the eye-sockets small,

the face rather large though without prominent cheek bones, but the jaws were short and powerful, and the masticatory muscles strong. Her teeth had been good enough but were now much worn, so that the lower portion of the face had become shortened, but it was no wonder for as a general rule she had to be content with plain, tough, and often even bad and little nourishing fare and be thankful too. She was somewhat better off for clothes for she spun much wool year in, year out, and sometimes had some of her master's or mistress's discarded clothing given to her, for there was not much difference then between a man's and a woman's dress. She was fairly strong for the muscles of her arms were well-developed and had to work much, but her arms had little by little become curiously slanting from the elbows, and it did not look nice when the forearms and the coarse clumsy hands rough with work actually projected from her body when she turned the palms of her hands forward. Otherwise it was not very noticeable, particularly when the arms were bent at the elbows or hung down along the sides with the palms turned towards the thighs.

When she was 25 years old or thereabouts her life came to an end. Like the other inhabitants of the settlement she never grew old, life in the severe cold of these regions had gradually become too hard to live. She died and was buried in her old patched clothes directly in the damp earth, for the times when coffins could be provided for people of her sort were long since past. During the short summer in the churchyard the plants still sent their roots deep down into the soil, so that living roots at last grew all through the clothes and the dead human bodies, penetrating even into the most delicate pores of the bones, while the acid humous substances of the soil slowly and gently dissolved the hard lime of the skeleton, at the same time tanning and preserving the soft organic connective tissue substance. Some lime was, however, left, and the enamel of the teeth was too solid to be quite dissolved, it remained hard, only growing still more brittle than before.

At that period, several years or even a short lifetime later, the cold had gradually grown so severe that the earth only thawed for a shorter and shorter time each summer. At last the earth froze permanently round the body in the lower part of the grave, while the upper part of the grave still thawed for a short time every year. Finally the grave with its contents froze to the bottom and never thawed again, so that all that was still left of the bodies of the dead, the skeletons penetrated by plant roots, and the clothing in which they were encased, the simple wooden crosses which accompanied them in their graves, all was preserved unchanged for 500 years.

The Deterioration in the Climate

Perhaps the most important cause of the decline and final extinction of the Norse colony in Greenland was the deterioration in the climatic conditions to which reference has been made several times.

When the Norse Greenlanders first settled, they brought with them cattle and sheep, which are known to have been successfully reared during the first centuries of the existence of the colony. In the "King's Mirror"[2] we read: "It is reported that the pasturage is good and that there are large and fine farms in Greenland. The farmers raise cattle and sheep in large numbers and make butter and cheese in great quantities." They even attempted to raise grain. At present it would be impossible to obtain sufficient winter fodder for herds of cattle. In fact, cattle are found in only one place. To grow grain would be quite hopeless.

Old records mention an increase in the masses of ice that drift along the coast; and it is difficult to understand how the early Norse settlers were

[2] Speculum regale, transl. by L. M. Larsen, American Scandinavian Foundation, New York, 1917.

able to sail to and from South Greenland if the ice conditions were as bad as they are now.

The migrations of the Eskimos point in the same direction. According to Dr. Nörlund the Eskimos follow the seal, which prefer moveable ice; they cannot exist on ice-free coasts. When the Norsemen settled in Greenland they found trace of the Eskimos, who evidently had lived there but had again migrated to the north. In the thirteenth century, however, they reappeared and advanced persistently southward until finally, by the middle of the fourteenth century, they had occupied the Western Settlement, which apparently they destroyed. One or two centuries later they inhabited the entire west coast down to Cape Farewell. Dr. Nörlund believes that only fluctuations in the ice conditions can explain these migrations.

The most conclusive argument in favor of the increased severity of the climate is the fact that the wooden objects and woven costumes in the cemetery of Herjolfsnes were preserved for some five hundred years. The nature of the soil cannot account for this, as the soil was gravel and sand, which has small preservative power; but all the well preserved finds were exhumed from layers that at the present time are frozen all the year round, and we may safely conclude that this determined their preservation. Yet these objects must have been buried under conditions where the soil was thawed, at least at midsummer. All but one of the costumes, even the very deepest-lying, and many of the coffins were pierced by and matted with the roots of plants, a fact that cannot be explained otherwise than by their having been in a thawed condition when this occurred. Hence the only explanation is that the climate became more and more severe.

No quite satisfactory explanation has been found of this change in climate; perhaps the best is that given by the Swedish geophysicist and hydrographer Professor O. Petterson,[3] who ascribes it to periodic variations in the combined attraction of the sun and the moon. This attraction is greatest during the coincidence designated as a perihelion-node-apside, in which both sun and moon reach their closest proximity to the earth and maximum of declination. This coincidence occurs about each 1850th year. It occurred last in the year 1433 A. D. and before that about 350 or 400 B. C. It causes violent fluctuations in the tides, results in destructive bores, and would, according to Professor Petterson, cause the ice masses of the Arctic to break up and drift southwards, entailing great changes in climatic conditions of the arctic and subarctic regions. This theory seems to be supported by various occurrences in Scandinavia and northern Asia but cannot be said to be quite substantiated.

Professor Petterson's explanation apparently fails to account for the fact that ice conditions seem to be at least as bad at the present time as they were in the fifteenth century. If the change in climate were due to cosmic periodically recurring events, as he suggests, we might expect that

[3] See the review of his paper "Innere Bewegungen in den Zwischenschichten des Meeres und der Atmosphäre," in this number of the *Geogr. Rev.*

the ice conditions, having reached their maximum of intensity about the year 1400, would, during the following 500 years thereafter, show a marked improvement, since 500 years is nearly one-third of the period of time indicated by him.

Whatever be the explanation of the change in climate, there can be no doubt that it did actually take place, and it seems likely to have been caused by or at least associated with a change in ice conditions. It follows that the surrounding regions of land and sea must also have been affected, and it would be interesting to know whether such a change can be traced with certainty in Iceland and whether perhaps it contributed to the decline in prosperity and vigor of the population of that island which took place at the end of the Middle Ages.

In Flóamanna Saga it is related that an Icelander, Thorgils Orrabeinsfóstri, sailed from Faxafjord in Iceland to Greenland, probably in the year 998[1]. After having drifted about on the sea for several months, the ship stranded on the east coast of Greenland and broke in two. The shipwrecked people lived for two years at the bay where they stranded, being unable to get away on account of the dense masses of ice that drifted past outside, almost incessantly barring the entrance. Finally they built a skin boat and worked their way south along the coast, but on this voyage they suffered the greatest hardships and did not reach Ericsfjord until about two years later. This account would seem to indicate that ice conditions about the year 1000 were already very bad, but perhaps the place where Thorgils stranded was very far to the north, even beyond Angmagssalik. The long time occupied on the voyage to Ericsfjord and the fact that Eskimos were met with on several occasions point in this direction, for it is known that no Eskimos were found in South Greenland at that time, while they may have existed at Angmagssalik.

Relations with Eskimos

By the year 1400 the Eskimos had probably advanced southward along the west coast as far as the Eastern Settlement, and the relations between them and the Norsemen were not altogether friendly, judging from the report of the destruction of the Western Settlement and later Eskimo tales and traditions. Nothing has come to light in the excavations of Herjolfsnes pointing to an intermingling of the two races, nor is there any indication in the finds of that locality that the Norsemen imitated or adopted the Eskimo culture, as suggested by Dr. Nansen. It seems indeed reasonable to conjecture that the Norsemen, when they were cut off from Europe, would adopt a civilization so perfectly suited to the arctic environment and, in particular, that they would take up the Eskimo mode of hunting the seal. That this did not actually occur at Herjolfsnes may perhaps be explained

[1] William Hovgaard: The Voyages of the Norsemen to America (Scandinavian Monographs, Vol. 1), New York, 1914, p. 69.

by the fact that at that time the Norsemen were in an extremely enfeebled condition, which rendered them unfit for the difficult task of building and handling kayaks, the skin boats of the Eskimos, as well as for the use of Eskimo weapons and the hardships of their life of hunting.

The End

The noted Icelandic author Björn Jónsson of Skardsaa wrote in 1625 of "an Icelander named Jón Greenlander who within 'living memory' had related how he had once been blown off his course and come to Greenland on board a German merchantman. According to computation it may be assumed to have occurred about 1540. The ship entered a fiord with many islands. Several of them were inhabited (probably by Eskimos). These they dared not, however, approach, but went ashore on a small uninhabited island where there were boathouses and stone walls quite like those in common use in Iceland. 'There they found a dead man lying prone. On his head he had a well-made hood, his other clothing being partly of frieze partly of sealskin. By his side lay a bent sheath-knife much worn and wasted by repeated whetting. This knife they took away with them as a souvenir.' "

Dr. Nörlund adds: "It is hard to know how truthful a witness Jón Greenlander was, but his account bears throughout the stamp of credibility. It represents to me a most tragic picture of the end as I believe we must most probably imagine it. The last Norseman, clad in a dress like those now found at Herjolfsnes, lying dead and unburied by his desolate and deserted dwelling and holding in his hand the emblem of the cultural superiority of the European, the iron knife which had been ground and ground to the extreme verge of possibility. And when that verge was reached the European succumbed and the hardy Eskimos, the small Arctic race adapted to the physical conditions, took possession of the land by the right of the strongest."

While it seems certain that the end of the colony at Herjolfsnes was substantially as described by Dr. Nörlund and Professor Hansen, it does not necessarily follow that events took the same course at other parts of the widely scattered settlements. Herjolfsnes was situated at the extreme wing of the Eastern Settlement, and with the poor means of communication available in later times, especially the absence of good boats, the small population was probably in an isolated position. It is not impossible that the larger settlements at Gardar on Ericsfjord and elsewhere may have fared better and may have endured longer than at Herjolfsfjord. It may be that intermingling with the Eskimos has occurred. At any rate, until it has been proved by further investigations that conditions similar to those at Herjolfsnes existed elsewhere, it seems unsafe to generalize from the sole experience at that small outlying settlement.

THE TOPOGRAPHY OF THE AMAZON VALLEY

By C. F. Marbut and C. B. Manifold

U. S. Department of Agriculture

[With separate map, Pl. V, facing p. 642]

In a region like the Amazon valley opportunity for travel is presented mainly by the rivers. On account, however, of the activity of the rubber gatherers for the last two or three decades the rubber-growing regions have been traversed in all directions by trails. This is especially true of the upper Purús, the Acre Territory, and the upper Juruá country. Elsewhere trails are few, running from the navigable rivers only short distances into the country. The passable trails as a whole are fewer now than formerly. For example the maps show a long trail extending from Labrea on the Purús southward to the Campos country, lying between the Aquiry and the Madeira, which is reported impassable because of fallen bridges. The road from Riberalta, Bolivia, to the Mamoré River opposite Guajará-mirim is reported impassable also. The same is true doubtless of many others because of the decline in the rubber industry, though it is still sufficiently important in the Acre-upper Purús-upper Juruá country to keep the trails open.

The data set forth in this article[1] were collected by the authors during travel by various means—on the rivers by steamboat or launch, rarely by canoe, on land by horse or mule, and on the Madeira-Mamoré and Bragança railways. Short trips were made on foot. Some information was obtained regarding regions not reached by either of the authors from residents and traders along the route; and the literature, so far as it concerns the special features discussed in this paper, has been carefully examined.

The Inner Amazon Basin

The area discussed may be called the Inner Amazon Basin. It is concerned mainly with the region of unconsolidated sands and clays colored as Miocene and Quaternary on Branner's[2] geological map of Brazil and country of the same general character in eastern Peru and northeastern Bolivia.

The area extends from Bragança, about 100 miles east of Pará, to the Pongo de Manseriche on the Marañon River in Peru—a distance of about

[1] The objective was the Crude Rubber Survey of the U. S. Department of Commerce, August, 1923, to May, 1924. See also W. L. Schurz: The Distribution of Population in the Amazon Valley, *Geogr. Rev.*, Vol. 15, 1925, pp. 206–225.

[2] Mappa Geologico do Brazil, accompanying the article by J. C. Branner: Outlines of the Geology of Brazil to Accompany the Geologic Map of Brazil, *Bull. Geol. Soc. of America*, Vol. 30, 1919, pp. 189–337.

2200 miles. Its width varies greatly: it is shaped like a spatula. A line across it at its widest point, along the 68th degree of longitude, is about 800 miles long; and across the handle of the spatula, in the longitude of Santarém, it is not more than 200 miles.

This great area is a broad, shallow trough with the Amazon River lying, presumably, along the bottom but in an unsymmetrical position with respect to the northern and southern boundaries, i. e. nearer its northern than southern side.

The south-bank tributaries of the Amazon are longer than those of the north bank, and their courses lie at a higher angle with that of the main stream, making the belt drained by them much wider than that of the north-bank streams. The basins of the south-bank tributaries are also unsymmetrical, their right-bank tributaries being longer and larger than those of the left bank. This is true, however, only of those right-bank tributaries of the Amazon the axes of whose basins lie at an angle smaller than 90 degrees with the axis of the main stream. The basins of the right-angled tributaries are approximately symmetrical.

Geological History

It is not necessary to discuss the details of the geology of the region or of its geological history. A general outline of its history, accepting the work of Katzer[3] as the most authoritative, is about as follows.

The older Tertiary rocks lie along the lower Amazon, and the younger in the upper part of the basin; after the deposition of the older beds the lower Amazon region was raised above the sea. The Andes Mountains were uplifted long after the lower Amazon region was uplifted; and, from the time when the latter uplift took place until the uplift of the Andes had made considerable progress, the drainage of what is now the Inner Amazon Basin was westward into the Pacific. With the uplift of the Andes the westward outlet was closed, and for a period of undetermined length the upper basin existed as an enclosed sea receiving the drainage of the surrounding country. An undetermined thickness of the sands and clays constituting the deposits of the upper basin was laid down during this time. With the progressive uplift of the Andes and the filling of this inland basin the drainage was finally turned eastward, and the Amazon River came into existence. The belt of Quaternary deposits shown on the Branner geological map seems to be based mainly on the work of Katzer and includes the existing flood plain of the Amazon and some of its tributaries and also, as will be seen below, belts several miles in width on one or both sides of the river that at the present time constitute true upland. No attempt will be made in this paper to differentiate between this Quaternary upland and the upland on the Miocene beds. Katzer[4] states that the

[3] Friedrich Katzer: Grundzüge der Geologie des unteren Amazonasgebietes, Leipzig, 1903, pp. 239–262.
[4] Katzer, *op. cit.*, p. 108.

FIG. 1

FIG. 2

FIG. 3

FIG. 1—Bluff two miles below Manáos. (Photograph by C. F. Marbut.)
FIG. 2—Bluff on the Solimões at Fonte Bôa. (Photograph by Dr. Avelino de Oliveira.)
FIG. 3—Bluff at Parintins. (Photograph by C. F. Marbut.)

Tertiary deposits of the lower Amazon do not differ petrographically from the Quaternary deposits in the same region; and, since neither consists of marine deposits and both are young, they do not seem to differ paleontologically, though Katzer is silent on that point. He bases his differentiation on the uniformity in facies of the Tertiary over a large area and presumably, though he does not say so in so many words, on the lack of this uniformity of the Quaternary deposits. He states that the two deposits cannot be sharply differentiated. He described the thick deposits of which the prominent mesas lying on both sides of the river between Parintíns and the mouth of the Xingú are built up as late Tertiary in age. They constitute, in his opinion, remnants of the deposits made in the lakes existing in this region between the time when the original westward drainage was blocked by the rising Andes and the newly formed Amazon had become definitely established. These mesas rise to nearly a thousand feet above sea level and several hundred feet above the general level of the uplands around them. If the deposits of which they are remnants are of very late Tertiary age and were made immediately before the development of the Amazon River it is evident that the erosion which has reduced the surrounding country and isolated them as remnants has been performed by the Amazon itself and not by such streams as may have drained this region westward before the birth of that river. If this be the case the Amazon River cannot be considered, at least in its lower course, a young river still seeking a place where it may develop a valley. The region cannot be considered a *terra immatura*.

The Valleys

The valley of the Amazon River below the Pongo de Manseriche in Peru and those of all its tributaries lying within the region of unconsolidated rocks are well graded, have normally developed profiles of equilibrium, and in all respects are like those of streams in an early mature stage of development wherever they may be found. The valleys are in no apparent sense unique except in the mere matter of the size of the master stream. There seems to be no indication that the stages through which the various streams of the area have passed to reach their present maturity have been marked by any unusual occurrences. The flood plains are broad, and their cross sections are in every way normal. Along the immediate stream banks the natural levee is well developed, and the texture of the alluvium is relatively light. It is narrower than the natural levee along the banks of the Mississippi, and the material is heavier than that along the latter stream.

The back swamp is in every way as characteristically developed as on the lower Mississippi. On the Amazon it is often treeless, while on the lower Mississippi this is rarely or never true; though on the upper Mississippi treeless areas with heavy soils are of rather common occurrence. On the Amazon it is flooded for a longer period than the natural levee, water stands

on it for a longer time, and after the flood has subsided it contains many lakes, some of which are permanent.

It does not follow, however, that the channel of the Amazon is as free from islands as that of the Mississippi or that the alluvial plain is free from lakes and sloughs. The map (Pl. V, facing p. 642) shows that the channel has many islands and that the back swamp has many lakes and sloughs, the *paranás* and *furos*. Their existence, however, does not imply a less mature stage of development in valley building than that of the lower Mississippi nor does it imply the absence of the marks of this maturity.

The presence of such a great number of lakes and sloughs in the Amazon valley is possibly due to the annual inundation and to the finer-grained load carried by the river as compared with the lower Mississippi. The Mississippi tends to maintain a natural levee but slightly higher than the back swamp, and the Amazon tends to keep the low parts of the back swamp filled with water. Whatever the cause, the lakes and sloughs cannot be considered as evidences of an immature stage of valley development. No measurements of differences of elevation between the natural levee and the back swamp were made. It is unnecessary to describe them in greater detail since no contribution was made by the expedition to the knowledge of these features. Their identity with such features on all large rivers in comparable stages of development is evident. They have been fully described by Le Cointe.[5]

It is apparent that the region around the mouth of the Amazon has been somewhat depressed in recent geological time. The river not only has no delta, but the tide is felt as far up as Obidos, more than 600 miles by water from Pará. Since, however, there is at no time during the day, at least above the head of the island of Marajó, a reversal of the downstream current it does not follow that mean low water at Obidos is equivalent to low tide or mean tide in the Atlantic.

No one will be surprised at the statement that such elevations of points along the Amazon as are given in the literature are of doubtful accuracy. No line of spirit levels, much less of precise levels, has even been run up the river. The only determinations that have been made are barometric; and, where differences in elevation between places, even those many miles apart, are as small as they are on the Amazon, such determinations must be made with extreme care if they are to have any value. There seems to be no available information regarding the care with which observations on the Amazon have been made.

Le Cointe makes very few statements about elevations. The elevation of the port of Manáos is given as 26 meters, but the exact point whose elevation was determined is not described. The elevation of Pebas on the Marañon in Peru is given as 105 meters, but the exact spot referred to is not given. A rather large number of elevations is shown on the Amazon

[5] Paul Le Cointe: L'Amazonie brésilienne: Le pays—ses habitants, ses ressources, notes et statistiques jusqu' en 1920 (2 vols., Paris, 1922), Vol. 1, pp. 148–181; Vol. 2, pp. 54–92.

River charts published by the U. S. Hydrographic Office in 1882. While the observation spot in all cases is marked on the map its position is not described; and the reader, even though familiar with the local topography, in most cases is unable to determine definitely whether the spot lies on top of a low bluff, on a slope, or at some stage of the water in the river.

The Alluvial Plain

Notwithstanding the existence of a great deal of definite information regarding the width of the Amazon flood plain, much popular misconception still prevails. On account of the dense forest cover and the lack of roads, travel has been performed from the earliest days by boat. The traveler sees high land but a few times between Pará and Manáos, or even well up into Peru. He more or less unconsciously thinks of these points of upland as islands in an otherwise boundless area of lowland submerged during high water. Another factor accounting for popular misconceptions is the misuse of terms in describing the geological deposits of the Inner Amazon basin. It is practically universal for German and English writers at least to describe the unconsolidated sands and clays underlying the uplands of the Amazon region as *alluvial deposits*. The broad use of this expression does not differentiate the uplands from the true alluvial lowlands of the valley proper; and the matter is not cleared up and held consistently clear by even the most authoritative recent publications. Even Le Cointe in his general discussion seems to imply that the area flooded annually is much larger than it is, although a careful reading of his detailed descriptions and his large-scale map of the lower Amazon[6] show with great accuracy the width of the true alluvial belt below Manáos.

Denis is the most extravagant of all in his description of the immense area subjected to annual inundation: "A vast wilderness, almost absolutely level, with a few hills of granite strewn upon its surface; low-lying plains covered by annual inundations; dry land rarely advancing as far as the river's banks. . . ."[7] On the other hand, the true width of the valley from Manáos to Gurupá was shown on a small-scale map by Smith[8] as early as 1878. In one or two particulars, especially in the vicinity of Parintíns, he seems to be more accurate than Le Cointe.

As will be shown below, the valley, or flood plain, of the Amazon is narrower than that of the Mississippi between Cairo, Ill., and Baton Rouge, La., and its boundaries with the upland are just as well defined. No attempt will be made to describe in detail the width of the valley below Manáos since it is so well done by Le Cointe and Smith. Only a few localities where the evidence points to a somewhat different conclusion from that shown by Le Cointe's map will be mentioned.

[6] Paul Le Cointe: Carte du cours de l'Amazone depuis l'océan jusqu' à Manaos et de la Guyane brésilienne, 1:2,000,000. *Ann. de Geogr.*, Vol. 16, 1907, Pl. IV.

[7] Pierre Denis: Brazil. London, 1911, p. 357.

[8] Herbert H. Smith: Brazil: The Amazons and the Coast. New York, 1879 (map as frontispiece).

The map, Plate V, facing p. 642,[9] shows the width of the Amazon and its tributaries in so far as existing knowledge will permit. From Manáos to the mouth the data for the width of the belt are taken, with few exceptions mentioned below, from Le Cointe's map. Elsewhere the width of alluvial plains as shown is based on data obtained by the authors.

The tidal stream on which the city of Pará (Belem) is situated is not flanked by alluvial lands; the upland on the island of Marajó and that on the mainland from Pará to the Atlantic form the banks of the stream. Above Pará the channel through which up-river traffic passes flows between low alluvial banks except in a few cases. A detailed description of the intricate network of channels, alluvial islands, and occasional upland remnants would be unwarranted in a general paper even if our knowledge were complete.

It will be noted that the western part of the island of Marajó is alluvial and the eastern part upland, the termination of the upland along the southeastern side of the island being at Ponta de Pedras. West of this for a considerable distance the river bank is alluvial. A small remnant of upland presents a site for the village of Curralinho, another one for Brèves, and still another for the shipping station of Antonio Lemos. Smith[10] states that the whole of the island of Marajó is alluvial except a fringe along the south and east sides. He does not discuss the matter further, but it is apparent that he had in mind this western part of the island and that there are probably other remnants of upland than the three just mentioned. It is probable that Boa Vista stands on one; though no stop was made at the place by the Commission, and no definite information was obtained. There seems to be no definite information regarding the upland south of the river, but evidently the upland there exists only as rather narrow strips between the valleys of the numerous parallel rivers, all of considerable size, that drain the country for a long distance to the south. It is probable that Portel stands on an upland fragment, as well as Melgaço.

It is also probable that the western part of the island of Marajó, shown as alluvial, has a number of small remnants of upland similar to that at Brèves scattered over it, each one being a fragment of an upland ridge between the northerly flowing parallel streams south of the channel which formerly discharged into the Amazon on the north side of this belt, now designated as alluvial. Le Cointe's postulation of a similar course for the Tocantíns is possibly correct but seems to stand on somewhat less convincing evidence than does the case for these smaller streams. The main channel of the Amazon lying north of the island of Marajó is not bordered by an alluvial plain. The large islands in the mouth of the river, Mexiana and Caviana, are mainly upland islands similar to Marajó.

The first point at which the true width of the river valley may be seen, unmodified by valleys of tributary streams is opposite the village of Gurupá.

[9] M. Le Cointe's valuable map (footnote 6) has been especially used as a base for the relative portion of the map whence longitude is shown west of Paris.

[10] *Op. cit.*, p. 88.

FIG. 4.—Bluff on the Purûs near Ipiranga. (Photograph by C. F. Marbut.)

The village stands on upland, though there seems to be no evidence as to a continuity with the upland east of the Xingú south of the village; but it is assumed to be the northern point of the upland separating the valley of the Xingú from that of the Anapú.[11] Le Cointe gives its elevation above the highest flood level as about 20 feet. The width of the alluvial plain opposite Gurupá is about 20 miles.

Opposite Santarém the apparent width of the valley is much less than below or above this point. Le Cointe gives its width as 25 kilometers (16 miles). He measures it from the south side of an isolated upland island standing in the flood plain. The true width should, however, be measured by the distance from Santarém to the upland east of Alemquer and north of the island: thus measured the width is a little more than 20 miles.

Le Cointe shows the entire island of Tupinambarana, extending from Ideal on the Madeira River to the outlet of the Paraná de Canumá below Parintíns, as alluvial land. The site of Parintíns was visited by the Commission and proved to be on an upland identical in character and elevation with that at Gurupá. No opportunity was presented for an examination beyond the site of the village. A visit was made to the island at Tabocal southeast of Itacoatiára, and it was found that the river washes the foot of a well defined upland for a few miles. The elevation ranges from 25 to about 40 feet above high water, and the upland is well dissected as far as can be seen from the top of the bluff. The Pinto map of the Amazon[12] published by the Brazilian Government in 1866 shows a bluff along the river a few miles below Tabocal extending intermittently for several miles. The existence of a number of houses in this stretch tends to confirm the identification of this as upland. The island was visited by the Commission at Ideal, at its extreme southwestern end, where it consists of undulating upland some 30 feet higher than high water in the Madeira. At a point

[11] This point, all the island of Marajó, the Pará-Bragança region, and most of the upland touched by the river below Manáos are mapped as Quaternary by Branner. The determination of age is accepted as correct; but the maturity of this upland, assuming that this may be measured by the mature character of its soil cover, is essentially like that of the Tertiary rocks. It is *true upland* even though it may have been river alluvium at some previous time.

[12] Carta particular do Rio Amazonas, pelo Sr. José Soares Pinto, Capitão Tenente D. A. N. J., nos annos de 1862 a 1864.

FIG. 5—Bluff at Labrea, River Purús. (Photograph by Dr. Avelino de Oliveira.)

about 40 miles below Maués on the Paraná de Canumá a point of low upland was identified by the authors on the left bank of the Paraná, and finally Brown[13] shows a strip of upland along the axis of the island on his map of the lower Amazon. This island seems to be the product of the interaction of streams—the Madeira and Canumá—whose valleys were parallel and not far apart.

The width of the valley opposite Obidos is about 20 miles; opposite Parintíns it is about 30 miles; between Itacoatiára and the bluff on the south side of the valley at Tabocal the distance is only 10 miles. Itacoatiára and Tabocal are both on well defined upland, a few feet higher in both cases than at Parintíns. The valley here is unusually narrow and much narrower than at any point below. The rocks on the north side of the river at Itacoatiára are no more resistant, indeed are seemingly somewhat less so, than at Parintíns, and those on the south side are less resistant than at Itacoatiára. The situation is so unusual as to require explanation. Published accounts seem to offer no satisfactory explanation, and the Commission had no opportunity to study the region. There is one suggestion, however, that offers a possible solution. The Urubú River lies a short distance north of Itacoatiára, flowing eastward after having approached to within a few miles of the Amazon a short distance west of the town. Some 30 miles above Itacoatiára a *furo* runs from the Amazon eastward and enters the channel of the Urubú River. This rather strongly suggests the existence of a valley extending from the Amazon above Itacoatiára eastward, including the valley of the Urubú River, and opening into the Amazon below Itacoatiára. This may be a former course of the Amazon at a time when the Madeira occupied the valley south of Itacoatiára now occupied by the Amazon and the two rivers united below that town instead of above it as at present. If this be the history of development of this locality the width of the Amazon valley is to be measured from the north bank of the river valley southward to Tabocal, a width of 30 miles.

There seem to be no unusual features in the valley from this point for

[13] C. Barrington Brown: On the Ancient River Deposit of the Amazon, *Quart. Journ. Geol. Soc.*, London, Vol. 35, pp. 763–777.

several miles, according to the observations of the authors confirmed by the Amazon River Chart No. 892 of the U. S. Hydrographic Office.

The Madeira River Valley

The width of the Madeira valley between Ideal and the mouth of the Aripuana (Roosevelt) River is apparently very irregular. At the first right-hand bend below the mouth of the Aripuana the valley is less than three miles in width, and at Borba it is no more than that.

Between Rosarinho and Borba, a distance of about 60 miles, the river does not touch the left-bank upland, according to the maps of the Amazon River published in 1882 by the U. S. Hydrographic Office. This stretch was passed at night by the Commission, and no observations were made; but no reference has been found in the literature to the occurrence of any upland along the river in this stretch.

The first point above Ideal where the right-bank upland is seen is Caisara, about 30 miles above the head of the Paraná de Canumá. The Caisara bluff is continuous, with insignificant interruptions, with the right-bank bluff at Borba, about 16 miles farther upstream.

The left-bank bluff is washed by the river at Urucurituba about 15 miles below Rosarinho.

At Borba, however, the situation is unusual, on account of the restriction of the width of the valley to less than three miles. The presence of houses and fields on all the presumed upland behind the bluff lines as shown on the map lends probability to the accuracy of the identification of the bluffs as those of real upland. The map (Pl. V) shows another bluff on the left bank about ten miles above the bluff opposite Borba and another on the right bank about ten miles still farther. If there be no mistake in the identification of the upland on either side of the river, the Madeira valley is only about three miles wide for a considerable stretch. This we shall see is unusually narrow; but the narrowness appears not to be due to geological conditions, since there is no evidence that the rocks along this stretch are different from those in other places on the lower river. About 30 miles above Marepethi the river washes the bluff on the right bank at Sapucaiaroca at the mouth of the Jacaré River. This place also was passed by the Commission during the night, but from Vista Alegre to Itapinima the trip was made in daylight. Without detailed description it may be stated that there can be no question concerning the existence of upland at all points indicated between these places and that the identification of upland by the authors is in agreement in general with the charts of the U. S. Hydrographic Office.

The width of the valley below the mouth of the Aripuana (Roosevelt) River aswell as at Borba is undoubtedly too small to be regarded as the normal width of the Madeira, assuming that no mistake has been made in the identification of the upland. Such restrictions in the width of the valleys

of large rivers are by no means unknown. The explanation when not due to the presence of resistant rocks usually lies in the occupation, by a main stream, of the valley of a tributary for a greater or less distance above the point where the two streams united before the occupation. A number of cases have been described from the Mississippi system.[14] There are two groups of conditions in the region of the lower Madeira that suggest the possibility of a shift of the Madeira channel from a former course parallel with and to the northwest of its present course. One of these is the series of bluffs, as already noted, suggesting a valley width from Borba to Itapinima entirely too narrow for a stream as large as the Madeira; and the other is the Autas River, lake, and *furo*. The observations of the authors indicate that lakes on the uplands in the Amazon valley are extremely rare or wholly absent. Le Cointe's[15] upland (*terre firme*) lakes do not lie on the upland but in the valleys of small streams tributary to the lower Amazon just above where they open into the Amazon flood plain. They are identical features with the lakes along the Red River in Louisiana.

The Autas River valley was not visited, and no information whatever was obtained concerning it. The large lake in the valley is entirely too far away from the junction of the river with the Amazon to justify its explanation as a *terre firme* lake.

The most probable explanation is that it is a flood-plain (*varzea*) lake lying in a valley of abnormal width for the present stream. The Autas *furo* joins the Autas lake with the Madeira above Borba. It is difficult to see how such a channel could have been cut across the ridge between the two streams. A possible explanation is that the Madeira from above the mouth of the Aripuana originally flowed in a valley parallel with its present valley and on the north side of it and that the Autas River from the Autas lake or possibly above the lake down to its junction with the Amazon occupies this former valley of the Madeira. The Aripuana then flowed into the Amazon below the mouth of the Madeira along the valley now occupied by the Madeira. Through sidewise sapping of the upland between the two rivers they cut it away for a stretch of several miles above where Rosarinho is located and later at other points higher up and finally in the vicinity of the present mouth of the Aripuana. The Madeira occupied the Aripuana valley when it cut away the upland between them.

While this is based wholly on circumstantial evidence it offers a possible explanation of the facts.

The relation of the Madeira valley to that of the Paraná de Canumá through which a part of the Madeira reaches the Amazon a long distance below the principal mouth, is easily explained by the sapping of the narrow ridge separating the parallel streams.

Above the mouth of the Aripuana the valley is maintained apparently at a relatively uniform width. Between Manicoré and Democracia, both

[14] C. F. Marbut: Cote Sans Dessein and Grand Tower, *Amer. Geologist*, Vol. 21, 1898, pp. 86–90.
[15] L'Amazonie brésilienne, Vol. 1, p. 155.

on well defined upland, the width is relatively narrow but not narrow enough to require explanation. In all cases the upland above Manicoré was identified as such by the authors. It differs in a few points from the upland locations shown on the charts of the U. S. Hydrographic Office. In many places along the river the alluvial lands are high and have been mistaken apparently by the hydrographers for upland. All those high alluvial lands are subject to overflow, but the period during which they are flooded is

FIG. 6—Bluff on the Amazon half a mile below Obidos. (Photograph by C. F. Marbut.)

short. The soil profiles beneath such lands show them to have assumed the characteristics, though less strongly expressed, of upland soils.

From Santo Antonio to Guajará-mirim the Madeira runs over a series of rapids and low falls. There is no continuous belt of alluvium within this stretch. Above Guajará-mirim, however, there are broad belts along the Mamoré and also along the main tributary, the Guaporé. The width of these belts was not determined.

BENI, MADRE DE DIOS, AND ABUNÁ RIVERS

The only waterfall or rapid on the Beni system after its rivers leave the Andes is at Cachuela Esperanza some ten miles above its junction with the Mamoré at Villa Bella. Above the Cachuela the river winds through a relatively broad flood plain. The flood-plain boundaries are sharp, and the river wanders from one side to the other, the upland being washed by the river on one side or the other at intervals usually of ten miles or less.

No surveys were made of the river channel. The location of the river and its meandering course is accepted as shown on a map prepared by the

Bolivian military engineers[16] this being the one from which its course has been taken for the map (Pl. V). The width of the flood plain seems to be about seven miles up to Riberalta. The Beni above Riberalta was not visited, but the Madre de Dios was followed to Sena about a hundred miles, in a straight line, above Riberalta. The alluvial plain of the Madre de Dios up to this point is as wide as that of the Beni below Riberalta. There seems to have been no invasion of the valleys of parallel rivers

FIG. 7—Low upland at Codajaz, Solimões River. (Photograph by Dr. Avelino de Oliveira.)

in the Beni basin similar to that on the Amazon and Madeira. The rivers are smaller, and the upland is higher.

The Abuná River was ascended from its mouth to São Luiz in the Acre Territory. It has a strongly meandering course above the Cachoeira Fortaleza, about ten miles above its mouth. On a river trip of 240 miles from the mouth the upland was seen at about a hundred places.

THE ACRE-PURÚS VALLEY AND THE JURUÁ

At Cobija in eastern Bolivia the Acre is but little more than 120 feet wide; but it is navigable for small gasoline launches even in low water, and in high water river steamers reach the town with ease. The alluvial belt is narrow; but a low belt, seemingly a terrace, has a width of a little more than a mile. At Itú the belt flooded at high water is very narrow, but the low terrace-like belt is fully a mile wide. At Rio Branco the flooded belt ranges up to a quarter of a mile, but low terrace extends eastward on the east side of the river for somewhat more than a mile. A short distance

[16] F. M. Rivera: Mappa del territorio de colonias del noroeste, 1:1,000,000, Comisión Topográfica Militar, Cobija, 1922.

below Rio Branco the flood plain belt widens, though the low terrace-like land is seen at many places along the river as far down as Floriáno Peixoto.

The Purús above the mouth of the Acre was not visited. Below it the river meanders through a flood plain of considerable width, and according to reliable information the same condition exists farther upstream. Like the Acre, Abuná, and Juruá Rivers the upper Purús region is well known up to and even beyond where the river becomes too shallow for small launches.

The flood plain seems to present no unusual features, though there has apparently been some invasion of the valleys of parallel streams by flood-plain widening. The most evident case is in the vicinity of the mouth of the Tapauá.

The Juruá River was not visited. The geology of the region through which it flows seems to be exactly like that along the Purús. The course of the river as it is shown on the best maps available is in details essentially like that of the Purús. The country on both sides of the upper part of the river was, during the period when the rubber-gathering industry was active, one of the best of the rubber fields of the Amazon basin, standing next to the Purús as a producer. None of the literature describes the width of the valley or even mentions the localities where the river washes upland bluffs. The number of rubber stations shown on the best maps usually located at the extremities of river meanders on both sides of the stream make it extremely probable that they are located on upland and that a line, as in the case of the Purús, touching the oxbow extremities on both sides of the river would show approximately the bluff lines and the width of the valley.

The Solimões

Above the mouth of the Rio Negro the axial stream of the Amazon basin up to Tabatinga is called the Solimões; above that, the Marañon.

According to existing maps the width of the alluvial plain throughout the course of this river from where it leaves the Andes and enters the great Amazonian plain to the mouth of the Negro varies greatly and, according to this supposed width, may be divided into three stretches. From a short distance above the mouth of the Negro to a few miles above Manacapurú the plain seems to be about as wide as just below the mouth. The river touches the upland at a number of places in the north side of the valley, but the bluff on the south side seems not to have been defined. From the upper end of this stretch upstream to the outlet of the Paraná Avati a broad belt of alluvium is shown on all the Amazon maps. It has an average width of nearly 75 miles and is traversed in all directions by a number of *paranás* and *furos* communicating with the Solimões at one end and the Japurá at the other.

This region was not examined except for such observations as a steamer trip afforded. The stopping places, with a very few exceptions, are all on

the south side of the river, partly because the river touches the upland at many points on this side and partly because the rubber country lies almost wholly south of the river and the large tributaries through which this country is reached enter on this side.

The village of Codajaz on the north side of the river, located within the belt shown as alluvium on Amazon River maps, stands on a low area of upland apparently similar in character to the low upland on which the villages of Gurupá, Parintíns, and S. José stand. It is true upland at present. The profile of the soil covering it shows unmistakably that it has long been subjected to weathering and has received no river deposits on its surface. It is possible or even probable that it is a terrace remnant.

FIG. 8—Tapajóz River at flood stage with upland, near Aveiro. (Photograph by C. B. Manifold.)

Whether the long stretch of supposed alluvial land lying north of the Amazon channel west of this contains other areas of this kind or whether it contains isolated islands of still higher upland is not known. It is probable that such areas exist and in considerable number, as is indicated by an examination of the parallel courses of the Solimões and the Japurá from the entrance of the *paraná* down to its true junction with the Amazon. The area on which Codajaz stands is probably such a remnant.

A glance at any of the recently published maps of the Amazon basin shows the completeness of the drainage system. Many of the drainage lines are imperfectly located, but the upper part of the basin, especially the basins of the Madeira, Beni, Purús, and Juruá, have been penetrated in every direction during the last quarter of a century by rubber gatherers, and existing maps are based on information from these sources. While these streams have not been located by actual instrumental surveys, they are known to exist and their locations are approximately accurate. It is well known that such a drainage system cannot develop in a country covered with swamps. The existence of a well developed all-penetrating dendritic drainage system in any region is unmistakable testimony of the absence of swamps and lakes.

The Upland Drainage

The drainage net as shown on Plate V is copied mainly from the Millionth Map of Brazil for the region west of Manáos, and for the region east of Manáos from Le Cointe's large map.[17] A few changes have been made on the basis of information obtained by the members of the Rubber Commission, mainly from Sr. Monteiro da Costa, a member of the Brazilian part of the Commission. The Pixuna and Mucuim Rivers, between the Purús and the Madeira, are shown heading farther south and west than on any map of Brazil hitherto published. The position of the Iquiry, around its source and as far as the crossing of the trail from São Luiz to Rio Branco, has been shifted nearer to the Acre than on published maps. Some minor details of drainage have been added along the São Luiz-Rio Branco trail; and the drainage around the head of the Marmellos and the Machado, tributaries of the Madeira, has been reconstructed.

Many lakes are shown at considerable distances from all the large rivers. It is apparent that in most if not in all these cases they are flood-plain lakes whose locations have been reported by fishermen, hunters, rubber or nut gatherers. They usually report them as lying so many hours by canoe from the river. The slough connecting them with the river is characteristically crooked, but the map maker seems to have measured the distances to those lakes at right angles to the main river rather than at a low angle. The same statement applies to the courses of small streams also.

The Upland

The total area of recently deposited alluvium in that part of the Amazon basin occupied by unconsolidated deposits of Tertiary age approximates 120,000 square miles. The total area of this part of the whole basin is about 1,200,000 square miles. The alluvial land subjected to periodic flooding, usually though not in every case annual in occurrence, constitutes therefore about 10 per cent of the whole area of the region.

While the upland as a whole is low it is by no means flat. In all that part visited by the Commission it must be described as a well dissected undulating to rolling plain naturally well drained. According to information obtained from rubber gatherers the greater part of the region not visited by the Commission is of the same general character. Most of the region was visited during the dry season though by no means all of it, the Solimões, Marañon, and other parts of eastern Peru and the Tapajóz, Xingú, and Tocantíns regions having been visited in the height of the rainy season. In that part of the region visited during the dry season the character of the soil showed unmistakably that it had not been subjected during its development to the influence of excessive soil moisture. It exhibited those features universally recognized as the product of normal good drainage in soils as fully developed as those of our own coastal plain.

[17] See footnotes 6 and 9.

The area may be broadly subdivided into two plains, an upper and a lower. The lower lies along the rivers approximately in the axial belt of the river basin. The upper occupies the rest of the region. The lower plain seems to correspond approximately, from the mouth of the Madeira downstream, to the region mapped by Branner[18] as Pleistocene. A region above the mouth of the Madeira that seems to be part of this plain is crossed by the Purús below the mouth of the Tapauá, and at least a part of the broad belt of low country between the Solimões and the lower Japurá belongs to a low plain. This is undoubtedly true of the low upland at Codajaz, and the belt probably contains other areas of the same kind.

The Lower, or Marajó Plain

The lower plain, which will be designated the Marajó plain, covers all the upland portion of the islands of Marajó, Mexiana, and Caviana, the mainland south and east of the Pará River as far eastward as the Atlantic at Bragança and southward up the Tocantíns to a point 25 miles north of Baião, a strip of country on both sides of the Tapajóz and Xingú, a large part of the "island" of Tupinambarana, and the upland along the lower Madeira and the north bank of the Amazon for a few miles west of Itacoatiára. The area corresponds approximately to the upland portion of the area shown on the Branner geological map of Brazil as Quaternary below Tonantins.

The region around Pará, including the islands, and the country along the lower Tapajóz and Mojú consists of a smooth plain standing 25 to probably a maximum of 50 feet above mean tide. Between Pará and Bragança it is smooth but well enough dissected to afford good surface drainage in most places. One small area a few miles east of Castanhal station is flat and poorly drained. The surface of the island of Marajó seems to be flatter than most of the area, but the greater part of it is rolling enough to be free from large areas of standing water during the rainy season.

The village of Gurupá stands about 25 feet above high water, according to Le Cointe;[19] and presumably other parts of what seems to be an extension of the plain southwestward along the east bank of the Xingú are of about equal elevation. A bench extends along the Tapajóz on both sides of the river for some distance above its mouth. At Boim it is nearly eight miles wide, and south of Santarém it seems to be of about the same width. It is described by Smith,[20] but its width is not given.

Branner represents the whole of the island of Tupinambarana as Pleistocene and to this extent identifies it as part of the Marajó plain. The northeastern end at Parintíns has the same general character and about the same elevation above high water (25 feet) as the Marajó plain at Gurupá. The upper end of the island, south of the Furo de Ramos at Tabocal, is several

[18] See footnote 2.
[19] L'Amazonie brésilienne, Vol. 1, p. 75.
[20] *Op. cit.*, pp. 135–175.

feet higher than at Parintíns, standing some 40 feet above high water, and has apparently a more rolling surface. The surface here is also much less sandy in character than at the places already described. At Ideal on the Madeira the upland seems to be higher also than at Parintíns though not enough of it was seen to warrant a definite conclusion.

On the west side of the lower Madeira, however, at and below Rosarinho the upland seems to be like that at Parintíns; and the same is to be said of the low upland at San José on the north bank of the Amazon west of Itacoatiára.

The plain on which Codajaz stands is apparently a fragment of the Marajó plain, and what seems to be a low belt along the Purús below the mouth of the Tapauá may also be a part of it. At none of the places, either on the lower Madeira or west of it, are these low areas sandy. They all have a clay soil and subsoil.

The upland at Borba, Manicoré, and Democracia is low but somewhat higher apparently than the general level of the Marajó plain along the Amazon proper, and for this reason this part of the upland is included within the area of the higher plain.

The Higher Plain

The higher plain varies both in character of relief and in elevation from place to place. Nothing more is known of it east of the Xingú than that it extends along the east side of the river for some distance and along both sides of the Tocantíns and presumably occupies the country between these streams. Between the Xingú and the Tapajóz a smooth-topped plateau rises rather abruptly from the Marajó plain a few miles south of Santarém. Smith[21] describes its abrupt rise and mentions its smooth top, but he does not estimate its elevation above Santarém. Katzer[22] gives the elevation of the top of a ridge dropping abruptly at its northern end to the Amazon a few miles east of Santarém as 80 meters. This is presumably the plateau described by Smith. This seems to be merely the northern end of a smooth upland that extends southward for a long distance, presumably to the southern limit of the Tertiary deposits. The bluff at the north end of the ridge is the most prominent topographic feature to be seen on the south side of the river below Santarém. Katzer states that the northern end of the plateau a few miles southeast of Santarém attains rapidly an altitude of about 200 meters and that the top rises slowly southward to about 300 meters a hundred miles or more from the Amazon. Within the area of the Tertiary deposits it probably does not rise much above 200 meters. East of this ridge, which does not seem to extend to the east of the Curuá River, Katzer says the rise from the south bank is gradual but says nothing about the elevation that is finally attained.

[21] *Ibid.*, p. 144.
[22] *Op. cit.*, p. 67.

FIG. 9

FIG. 10

FIG. 9—Upland at junction of Javary and Solimões Rivers. (Photograph by Dr. Avelino de Oliveira.)
FIG. 10—Upland, northern part of Manáos, looking northwest. (Photograph by C. F. Marbut.)

The upland on the west side of the Xingú River at Souzel rises abruptly to an elevation of about 40 meters. The topography on the upland and the character of the soil are similar to these features on the plateau south of Santarém. This seems to extend southward to Victoria where it drops to the low undulating plain occupying the great bend in the Xingú between Fort Ambé and Victoria. The first high land seen on the west side of the Xingú lies about 25 miles above Porto de Moz. It is about 100 feet high and is evidently a part of the plateau noted at Souzel and at Victoria. It is apparent that the upland along the Xingú below Victoria is an eastward extension of that south of Santarém; but it is lower, indicating a slope eastward.

The same upland, or what seems to be the same, lies along both sides of the Tocantíns. At Cametá the upland seems to be part of the Marajó plain since it is only about 20 feet high. At Baião, and for several miles above and below, the upland lies a little less than 100 feet above the river. At Alcobaça there is a low bench of about 25 feet and a narrow strip of upland above it; beyond this mile-wide strip the upland plateau rises to nearly 100 feet above the river. West of the Tapajóz a number of plateau fragments rise to a maximum elevation, according to Le Cointe, of 152 meters within a very short distance from the river. The two most important are the Serra Parintíns and the Serra Balaio.

Since the upland on the west side of the Tapajóz for a considerable distance both to the north and the south of Itaituba is low and no highland is visible to the westward from the village it is apparent that the high plateau whose fragments have been described above does not extend southward into this region although it lies across the river east of Itaituba. It seems probable that the high country on the lower Tapajóz and east of Parintíns is a feature of the Tertiary deposits and that the southern boundary of this formation is marked by a southward-facing escarpment.

Very little is known of the character of the upland southwest from Parintíns. In the vicinity of Maués the prevailing upland belongs to the Marajó plain. About 50 miles below Maués the upland along the east bank of the Paraná de Canumá is about 75 feet high. It is in sight at several places below this and does not vary much from this elevation. South of Maués the elevation stands at about 50 feet for a distance of at least 40 miles, the highest point reached by the Commission; and residents report that bluffs 100 feet and more in height are first seen on the river about 80 to 100 miles above Maués. Presumably these higher bluffs are still within the Tertiary.

On the north bank of the Amazon from a short distance west of Obidos eastward to some distance beyond Almeirim there are a number of plateau remnants, constituting, with the exception of the hills at Monte Alegre, the most prominent topographic features visible from the river. The most westerly group lies between the Jamunda and Trombetas Rivers a few miles from the Amazon. Another group lies north of Obidos. The mesas of the

group between the Trombetas and Jamunda are a little less than 200 meters high, according to Katzer,[23] while the elevation of the group north of Obidos is about 150 meters. These are probably remnants of an old plain originally continuous with the one whose remnants lie around the mouth of the Tapajóz and westward to Parintíns. A description by Katzer[24] indicates that these hills stand well above the forested country lying north of them. Since, according to Branner's map, they must lie on or near the northern border of the Tertiary deposits it is apparent that these beds terminate in a northward-facing escarpment and maintain the characteristic plateau-like upland and a considerable thickness of beds up to the boundary.

The hills in the region around Monte Alegre are, according to Katzer, built of Carboniferous rocks. They rise higher than those around the mouth of the Trombetas, attaining a maximum elevation of about 350 meters according to Le Cointe, and have a less pronounced mesa-like character than the hills described above.

From a short distance northeast of Prainha eastward to within a short distance of the Jary river is a string of hills—about 235 feet high, according to Katzer—presenting strikingly well formed mesa-like characteristics when seen from the Amazon. The most westerly, the Serra do Paranaquará, seems to stand as an isolated mass, according to an illustration by Katzer;[25] but there seems to be no definite information in existence regarding the relation of its upland surface to that of the Tertiary country north of it. It is surrounded on the west, north, and east by the valley of the Jutahy and on the south by that of the Amazon though Smith[26] states that this and the other mesas of Tertiary rocks to the east stand on or rise from a low upland and not from the Amazon flood plain. It is evident from an inspection of Le Cointe's map[27] that he regards the Serra do Paranaquará (360 meters) as a part of a plateau of equal altitude lying to the north, isolated by the valley of the Rio Jutahy, and that the group of similar hills to the eastward consists merely of the southern ragged edge of this plateau where it drops to the valleys of the Amazon and the Parú.

It would seem that these plateau fragments are parts of an original plain and that the varying elevations are due to earth movements. The hard layer capping the plateaus is not a geological formation but a bed of accumulated iron oxide due to soil development. Its occurrence in two places, therefore, does not prove that the two beds are of the same geological age though both must have been in existence for a considerable time. In no other part of the central Amazon basin is the upland so high above the local drainage, and it is probable that it nowhere else attains an equal absolute height unless it be near the mountains.

[23] *Ibid.*, p. 4.
[24] *Ibid.*, p. 4.
[25] *Ibid.*, p. 7.
[26] *Op. cit.*, p. 631.
[27] See footnote 6.

On the Madeira and Abuná

The upper plain, or what we have identified as such, is rather low on the Madeira below the mouth of the Aripuana (Roosevelt) River. At Ideal it stands some 30 feet above high water and about the same at Itapinima, Manicoré, and Democracia. At the last-named place it seems to be a little higher, standing at 40 to 50 feet above high water. At Humayta it is about 60 feet, at Calama nearly 100 feet, at Porto Velho somewhat over 100 feet

Fig. 11—Recent clearing eight miles south of Cobija, Bolivia. (Photograph by C. F. Marbut.)

above high water and seems to lie at about this elevation between Porto Velho and Guajará-mirim. Although Branner's geological map shows crystalline rocks at Porto Velho (near S. Antonio) and thence inland from the river, yet all the upland from a mile back of the town to a distance of at least four miles is capped with material differing in no way, according to a rather superficial examination, from the unconsolidated rocks along the river below. Wherever the railway reaches the upland a few miles from the river the deposits seem to consist of unconsolidated sands and clays usually more sandy than below the mouth of the Machado. The railway runs over the upland a few miles south of the village of Abuná, and the cuts near the top do not expose crystalline rock. On the Pacanovo, a stream flowing into the Mamoré from the east a few miles above Guajará-mirim, crystalline rocks are exposed in a number of places in the river channel, but the bluffs consist of unconsolidated sands and clays or of iron oxide masses. The material is very sandy throughout all the Pacanovo valley. The upland is usually low, rarely rising more than 60 feet above high water, but the bluffs are well defined.

The upland rises as the Beni and Madre de Dios are ascended. At Riberalta it stands about 90 feet above the river and at Sena a little more than

100. The upland surface was examined at Riberalta, Sena, and Conquista and seen at many other places. At each place it is rolling.

On the Abuná the upland is invariably undulating to rolling. The maximum elevation above the river was somewhat more than 100 feet. In several places it ranged between 20 and 50 feet above high water.

From São Luiz, a rubber-shipping station on the river about 240 miles from the mouth, an overland trip was made to the Acre River about ten

FIG. 12—Upland five miles southwest of Yurimaguas, Peru. (Photograph by Dr. Avelino de Oliveira.)

miles below Rio Branco, a distance of some 60 miles. The trip was made at the end of October after the rains had begun. The small streams were still in low-water stage; but the Iquiry was in low-flood stage, and the Acre and Abuná had both begun to rise. During the first five hours of the trip a rolling country, well dissected to a depth of a little more than 60 feet was passed over. Its freedom from excessive moisture at any time was shown by its well oxidized soils and the abundance of rubber trees (*Hevea brasiliensis*). During the next two hours the country traversed was less rolling but still free from any suggestion of swamp. During the last hour and a half before camp was made, 25 miles from the start, the topography was rolling and much like the first stretch. On the second day a like distance was covered. The first three miles was over rolling land, the rest over smooth land across shallow ravines ranging up to a maximum of 40 feet in depth with gentle slopes as a rule. The soil showed signs of slightly imperfect drainage but complete absence of swamps even along the ravines. The abundance of Brazil nut trees indicated fair freedom from excess moisture, but the scarcity of Hevea an unfavorable condition for that tree.

The Iquiry River was reached at night, the descent from the low upland on the south side being very gradual. On the north side the rise is quite abrupt, and the height of the top above the river is about 140 feet. The rest of the trip to the Acre, about 15 miles, was over rolling country. The upland immediately along the Acre River lies about 75 feet above the flood plain.

FIG. 13—Topographic sketch along the northern half of the cart road from Cobija to Porvenir. Cobija is situated approximately in latitude 11° S. and longitude 68° 54′ W. (Greenwich).

ON THE ACRE

The narrow alluvial plain of the Acre at Rio Branco is bounded on the east side by a belt of low upland apparently not more than two or three miles wide. The true upland, lying close to the river on the west bank, is rolling with a local relief of about 100 feet or a little more. The upland from Rio Branco up river to about 20 miles above Xapury is low, in most places ranging between 15 and 40 feet above maximum high water. At a few places, however, higher land is touched by the river; but throughout the distance higher land seems to lie but a few miles away. At Itú it begins less than four miles southwest of the river. It continues thence southeastward for at least 25 miles as a rolling upland with a local relief within the Acre River drainage of about 100 feet and around the head of the Iquiry of about 50 or 60 feet. In the whole region there is no suggestion of swamps or even of imperfect drainage except in the belt lying between the river and the edge of the higher upland. A few miles above Porvir the upland on the west bank rises in two benches. The lower stands some 60 feet above high water and is but a few yards wide, while the upper rises to more than 100 feet above the river. From the top the same upland level on the east

side of the river is in sight a mile away or less. It is apparent that this is the general level of the upland southward for many miles and probably the same as that east of Itú and possibly that on the west bank of the Iquiry east of Rio Branco.

Above Porvir there seems to be no well defined low upland bench along the Acre. At Cobija the upland lies more than 100 feet above the river. The accompanying topographic sketch (Fig. 13) of a strip of country lying along the northern half of the cart road from Cobija to Porvenir is illustrative. As a whole this area is somewhat more deeply dissected than most of the region visited. The region west of Rio Branco and along the trail between São Luiz on the Abuná and the Acre River, the Beni and Madre de Dios region, and the Abuná and Purús regions are as *completely* dissected as this, but the *depth* of dissection probably ranges from about two-thirds to a half of what it is here.

Below Rio Branco the modern alluvial plain is, like that above the town, very narrow. The upland is at first low, ranging below 40 feet above high water, and is nearly flat near the river. It is probably a continuation of the up-river terrace or terrace-like upland. At Bom Destino this bench is about 35 feet above high water, but at Porto Acre the bluff is about 100 feet high. At Boa Vista, however, the upland is again only about 30 feet above high water, indicating that the higher upland at Porto Acre is not part of the terrace-like bench. Nova Andirá is 35 or 40 feet above high water, and a point on the same bank less than ten miles below is about 50 feet. At Porto Central the upland is about 100 feet above the river and at Floriáno Peixoto fully as high; but at Santa Rita, the only place where upland was seen between Floriáno Peixoto and the mouth of the Acre, the town stands on a bench 20 feet above high water. At the mouth of the Acre the upland on the west bank of the Purús is fully 150 feet above high water; and at Monte Verde, some eight or ten miles below, as well as at the mouth of the Inauhiny it is about the same in height or possibly a little higher than at the latter place. Between this point and the mouth of the Purús upland was seen at about 46 places. During the last two days travel was continued through the night, and it is probable that one or more upland points were passed.

The upland from the mouth of the Inauhiny to a point a short distance below the mouth of the Tapauá, except a stretch above and below Labrea, averages about 100 feet above high water or possibly somewhat more. Thence to a point a few miles above Ipiranga it ranges from about 25 feet above high water down to a very few feet. Below this point it is higher again, being about 80 feet in the vicinity of Ipiranga but apparently becoming lower northward. In the vicinity of Labrea the upland is less than 60 feet above high water, but the character of the country at some distance inland could not be determined. The fact that from Nova Olinda southward the country is rather well netted with trails and that the whole region is shown covered by a network of streams indicates that it is well dissected.

In what seems to be a low belt crossed by the river between Nova Olinda and Ipiranga there is doubtless some poorly drained country.

On the Solimões

From a few miles above the mouth of the Rio Negro to a point a short distance west of Manacapurú, upland lies almost continuously along the north bank of the river. It averages 40 to 75 feet above flood-plain level. Above this stretch the river banks are alluvial on both sides until Codajaz is approached, and the upland here is but a few feet higher than high-water level. It is reported that at flood stage the village site becomes a small island. The Pinto map of the Amazon River indicates an upland bluff along the north bank of the river for nearly ten miles below Codajaz, but if it exists it is even less conspicuous than the Codajaz bluff. The same map shows bluffs at several points above Codajaz also, but no such spots of upland were noted by the authors.

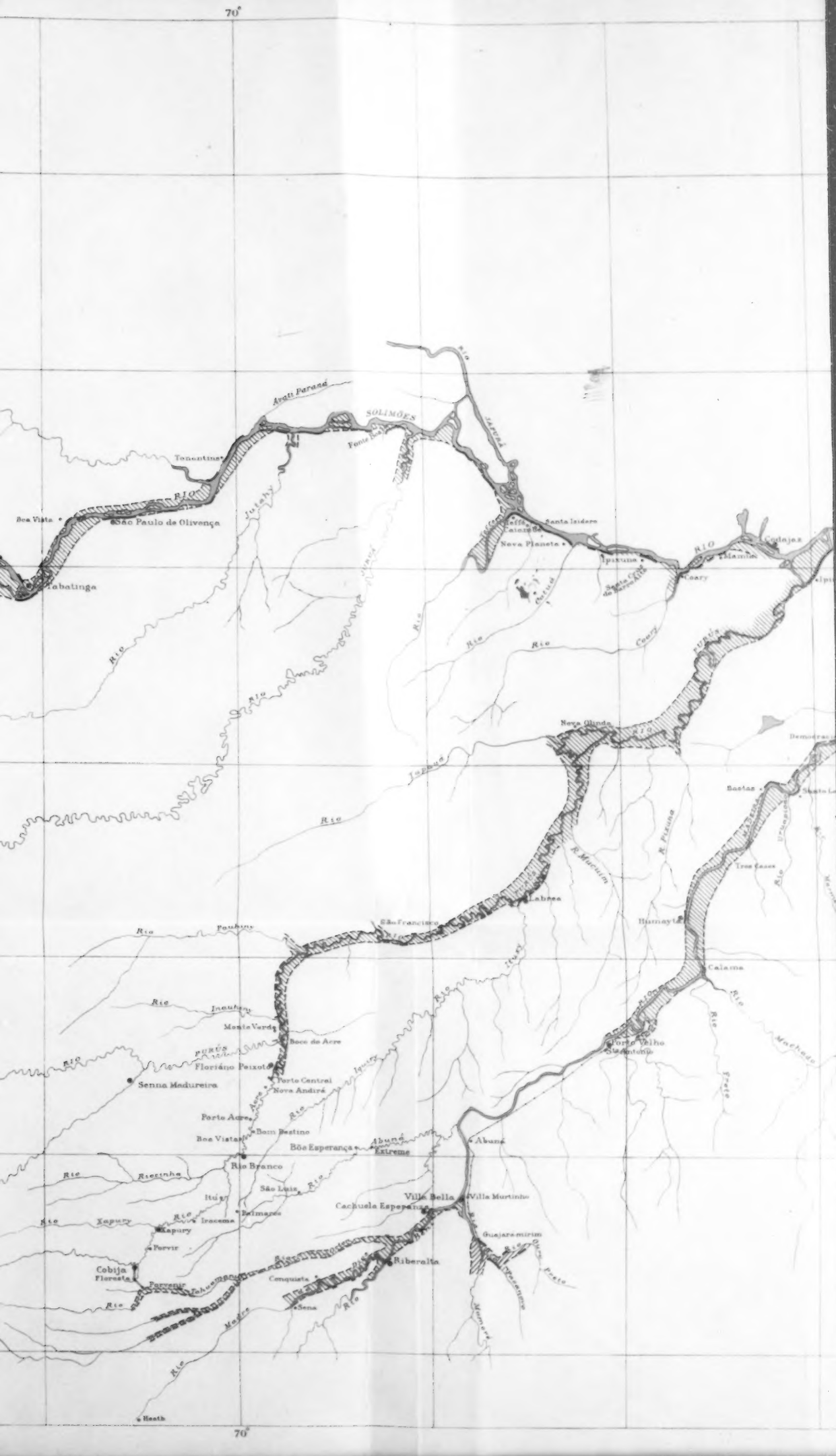
Well defined upland on the south bank of the river is touched for the first time at Mamia where it stands about 30 feet above water. From this point to the mouth of the Jutahy the right bank of the river consists of upland bluffs, or the upland lies not far away.

At Coary and for a considerable stretch below the village the upland rises immediately from the river to a height of about 50 feet above high water. Where it approaches the river west of the mouth of Coary River at Santa Cruz de Barro Alto it stands at about the same height and continues thence to Ipixuna and the mouth of the Catuá River.

The character of the country south of the river from its mouth up to the Catuá could not be determined, but west of this lies a dissected plateau that seems to extend at least as far as São Paulo de Olivença. It is dissected by the Teffé, Juruá, and Jutahy Rivers and their tributaries and is reported to have a rolling topography. It stands at least 100 feet above high water and is touched by the river in the form of prominent bluffs at Nova Planeta, Caiambé, San Izidoro, and São Paulo de Olivença. At intermediate points the immediate bluffs are lower, but in many cases the country rises within a short distance from the river to the plateau level.

Upstream from a short distance below Tonantins the flood plain is relatively narrow, and upland is washed by the river at many places on both sides of the valley. In general the bluffs are not so high as at São Paulo de Olivença. No definite information concerning the elevation of the upland at some distance from the river was obtained except that, between the Huallaga River at San Antonio de Yonayaco and the Ucayali due east of this point, the upland crossed by the Commission did not reach an estimated elevation of as much as 100 feet above the rivers but was thoroughly dissected and well drained. It was apparent, on approaching the ridge traversed by the Pongo de Manseriche water gap, that the upland became a little higher and a little more rolling than farther east.

80°
0°
10°
80°
IQUITOS
Pebas
Boa Vista
MARAÑON
RIO
MARAÑON
Javary
RIO
Yurimaguas
San Antonio de Tomayaco
HUALLAGA
RIO
RIO
UCAYALI
Río


70°
Avati Paraná
SOLIMÕES
Tonantins
Boa Vista
São Paulo de Olivença
Jutahy
Rio
Tabatinga
Japurá
Santa Isidoro
Nova Planeta
Ipixuna
Coary
Codajaz
Nova Olinda
Labrea
São Francisco
Paubiny
Inauhiny
Monte Verde
Boca do Acre
Floriano Peixoto
Senna Madureira
Porto Central
Nova Andiré
Porto Acre
Boa Vista
Bom Destino
Bôa Esperança
Rio Branco
Riosinho
São Luiz
Itaiy
Belmarco
Iracema
Xapury
Porvir
Cobija
Florenta
Conquista
Sena
Heath
Abuná
Extreme
Villa Bella
Villa Martinho
Cachuela Esperança
Guajaramirim
Riberalta
Humayta
Calama
Porto Velho
Santo Antonio
Machado
Preto
Ouro
Beni
Madre
Manoel
Purús
Iaco
Acre
Iquiry
Jurua
70°

60°
RIO NEGRO
SOLIMÕES
MANAÓS
Manacapurú
Codajaz
Coary
Alpiranga
Nova Olinda
Manicoré
Labrea
Humayta
Calama
Porto Velho
Santo Antonio
Villa Murtinho
Guajaramirim
Obidos
Parintins
Maués
Borba
Marapetha
Itacoatiara
60°

FLOOD PLAIN BELTS
OF THE
INNER AMAZON BASIN

LEGEND

Alluvial, periodically flooded

Upland, above maximum flood level

River bluffs, identified by the authors

Probable bluff lines

Scale of Miles

63 31½ 0 63 126 189

Scale 1:5,000,000

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The Geographical Review, Vol. XV, No. 4, 1925, Plate V

THE QUESTION OF PEARY CHANNEL

By LAUGE KOCH

The question of the Peary Channel has in the course of time called forth a whole literature, and as there now exists a definitive map of the regions that Peary assumed to be traversed by a channel, I shall try to explain the errors that have accumulated in process of time concerning this problem. There is the more reason to do so, since we owe it to the memory of Peary to meet the attacks that have been directed against him with regard to his explorations in North Greenland.

It seems most natural to commence with a survey of the literature dealing with Peary's journey in 1892 and by means of this to show what Peary really saw and mapped and what he only imagined he saw.

On Peary's return from his expedition he published in the New York *Sun* (Sept. 12, 1892) a letter dated St. Johns, Newfoundland, September 11, in which the channel is not mentioned. This letter was reprinted in the *Journal of the American Geographical Society*.[1] In the same volume of the *Journal* is found an address by Peary,[2] in which (p. 542) he says:

> . . . the entrance of a large Fjord came into view in the northwest, and soon after the land rose into view north and northeast *with the depression of the Fjord beyond it*.[3] I then deflected my course to the east, and soon found the land *and the Fjord beyond it*[3] again confronting me; deflecting still more, this time to the southeast, I advanced until the first of July, when a broad break in the land beyond the Fjord was visible opening out to the northeast, and I immediately made for the land with the intention of reaching this opening.

This quotation shows how much Peary saw from the ice cap. Concerning the view from Navy Cliff he writes (p. 543):

> To our left lay the depression of the Fjord which had barred our passage, and still farther to the northward we could make out the entrance of a second Fjord, reaching apparently to the northwestward.

These statements were published in the year of his return. At the same time Robert N. Keely and G. G. Davis of the relief expedition, whose information was based on Peary's account of the journey, expressed the idea of a channel thus:

> In the north was seen the mouth of a fjord reaching from the face of the glacier back into the land in a westerly direction, and probably connecting with Victoria Inlet.[4]

In 1893 we have another account by Peary in which he says:

> . . . we continued our march, always northeastward, till on the 27th of June I discerned black mountain-summits rising above the horizon of the ice-cap, directly ahead

[1] Mr. Peary's Return from Greenland, *Journ. Amer. Geogr. Soc.*, Vol. 24, 1892, pp. 470–473.

[2] R. E. Peary: The North Greenland Expedition of 1891–92, *ibid.*, pp. 536–558.

[3] The italics are mine.

[4] R. N. Keely and G. G. Davis: In Arctic Seas: The Voyage of the *Kite* with the Peary Expedition, Philadelphia, 1892, p. 395.

Fig. 1 Peary's Map, 1892

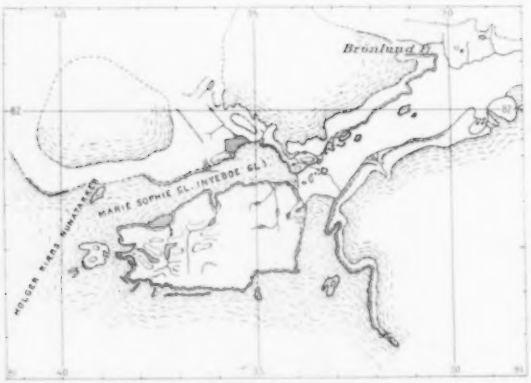

Fig. 2 Rasmussen and Freuchen's Map, 1912

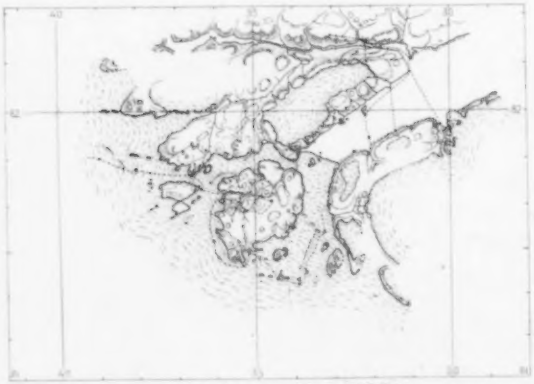

Fig. 3 Lauge Koch's Map, 1921

of us. Then the northwest entrance of a fjord came into view, *and we could trace its course southeasterly just beyond the nearer mountains of the land north and northeast.*[5] I changed my course to east, when I was soon confronted by the land and the fjord beyond. Then I turned to the southeast, and traveled in that direction until the 1st of July.[6]

The same year a weighty article by Cyrus C. Adams was published in the *Geographical Journal*. The writer stated that he had access to "the entire series of notebooks kept by Mr. Peary . . . , and, with the consent of the explorer, he has prepared this statement of some phases of the work." Mr. Adams says:

He was able to make out both shores of Victoria Inlet in the neighbourhood of its entrance into Lincoln Sea. He traced the higher mountains that border the northern side of the channel all along from Lincoln Sea to Independence Bay. He was unable, at his distance from the western edge of the ice, to see the southern border of the channel between 45° and 40° W. long.; but in his march along the edge of the ice-cap to the southeast he

[5] The italics are mine.

[6] Josephine Diebitsch-Peary: My Arctic Journal: A Year Among Ice-Fields and Eskimos. With an Account of the Great White Journey Across Greenland by Robert E. Peary. New York and Philadelphia, 1893, p. 226.

was able now and then to see the channel through rifts in the mountains that border it. He has no doubt that he has traced the northern border of the mainland and established the insularity of Greenland.[7]

In 1898 Peary's great report on the journey was at last published. Herein he writes:

> Our next march to the south-east was a short one, only ten miles, and nearly parallel with the land. Dark-brown and red cliffs looked down into a grand vertical-walled cañon reaching up towards our camp and everywhere north-west, north, and east, black and dark-red precipices, deep valleys, mountains capped with cloud-shadowed domes of ice, stretched away in a wild panorama. . . .[8]

Referring to the view from Navy Cliff he says:

> Looking to the west, we saw the opening of the fjord that had barred our northern advance. It was this fjord whose western entrance we had descried afar off days before. Now we knew that we had paralleled its course across the northern end of the mainland from Robeson Channel clear to the Arctic Ocean off the shores of north-east Greenland. For days we had kept constantly in view the mountain masses forming the southern boundary of this channel, and through rifts in the mountains we had from time to time seen this depression, and had now and then caught glimpses of the frozen channel occupying it; and we had seen beyond it mountains and fjords stretching between them. It was evident that this channel marked the northern boundary of the mainland of Greenland.[9]

This is all the information given by Peary as to his conjecture of a channel. It will now be interesting to see on Figure 3 where he traveled. We know, from his address[10] and from Mr. Adams' article,[11] that during the journey on the ice cap no astronomical observations were made. Peary traveled by means of an odometer, and only at four camps on the outward journey and three on the return was the position determined by means of astronomical observations. The only cartographic station during the journey was Navy Cliff, where Peary took theodolite observations, the results of which were published for the first time with the address.[12] Thus the map of the Peary Channel is based only on rough sketches. However, it would seem that one of the camps, the position of which has been determined by astronomical observations, is situated in about latitude 82° N. and longitude 40° W. From this camp Peary looked across the great ice-free land that now bears his name and realized that he was standing near the northeastern boundary of the ice cap. He must have had a wide view across a broad plateau traversed by great canyons and deep valleys, and he supposed that he was gazing upon "an archipelago whose western limits Lockwood had discovered in 1882."[13]

Just in front of him Peary saw a great glacier descending into a deep valley, and it seemed to him as if the valley opened out into a sound, covered with level sea ice. During the journey to the southeast Peary passed an-

[7] Cyrus C. Adams: Lieutenant Peary's Arctic Work, *Geogr. Journ.*, Vol. 2, 1893, pp. 303–316; reference on p. 310.

[8] R. E. Peary: Northward Over the "Great Ice," 2 vols., New York, 1898; reference in Vol. 1, p. 318.

[9] *Op. cit.*, pp. 345–346.

[10] See footnote 1.

[11] See footnote 7.

[12] Article cited in footnote 1, p. 557.

[13] Peary, Northward Over the "Great Ice," Vol. 1, p. 347.

other glacier that descended into a lake. A third glacier had no background of mountains. Looking eastward across the glaciers he now realized that he was standing above one of the great fiords on the east coast. The point is slightly northeast of Holger Kjaer's Nunatak. He now aimed for the land and in a few days reached Navy Cliff, and his conjecture of having been at one of the east coast fiords was confirmed. From Navy Cliff Peary observed a great depression to the northwest. He connected it with the depression parallel with the edge of the ice cap, which for several days had barred his way on the northeast. He had learned from experience how difficult it is to travel near the edge of the ice cap, and for this reason he remained on the level inland ice instead of attempting to follow the course of the depression. But, in the first place, he had a strong idea that all the glaciers stretching from latitude 82° N. to Navy Cliff ran northeastward and that the land between these glaciers was drained in the same direction; and, secondly, he saw a plateau to the north of the depression through which the glacier and the land were drained, a plateau whose rivers and valleys ran from the north towards the depression. Moreover, in a few places at the foot of the glaciers he saw level ice which he took for sea ice. His assumption of the existence of a channel was founded on the discovery of the great drainage system that separates Greenland proper from Peary Land.

Peary's only companion on the journey was the Norwegian Astrup, who related his experiences both in a lecture[14] and in a book.[15] The lecture was addressed to a wide public, and Navy Cliff and Independence Bay were only briefly mentioned, and the geographical results not further explained. Astrup's sketch maps do not correspond with Peary's maps; in particular as regards the northern border of the ice cap. In this connection it should, however, be noted that Peary's first maps of North Greenland differ greatly (compare, for instance, the map in "My Arctic Journal"). On Astrup's map there is no channel, a fact which provoked Charles Rabot's attack upon Peary.[16] This attack was answered from America.[17]

In 1900 Peary made a journey along the north coast of Greenland in the course of which he carried out a preliminary mapping of Lockwood's cairn and the northern and eastern part of the land which bears his name, but his discoveries on the journey had no bearing on the supposed channel. Some years later Peary's discoveries were entered upon official American[18] and Danish[19] maps.

[14] Eivind Astrup: Løitnant Peary's Grønlandsekspedition 1891–92, *Norske Geogr. Selskabs Årbog*, Vol. 4, 1892–93, pp. 25–44, with map of northern Greenland 1:6,000,000.

[15] Eivind Astrup: Blandt Nordpolens Naboer, Christiania, 1898; English translation by H. J. Bull: With Peary Near the Pole, London and Philadelphia, 1898.

[16] Charles Rabot: Les récentes explorations arctiques, *Compte Rendu des Séances de la Soc. de Géogr. [de Paris]*, 1894, pp. 428–437; reference on p. 433.

[17] Mr. Peary's Work in Greenland, *Journ. Amer. Geogr. Soc.*, Vol. 27, 1895, pp. 60–62.

[18] Baffin Bay to Lincoln Sea, Polar Regions, showing the recent discoveries by Civil Engineer R. E. Peary, U. S. N., 1:1,400,000, *U. S. Hydrogr. Office Chart No. 2142*, 1903.

[19] Kort over Grønland, udgivet af Commissionen for Ledelsen af de geol. og geogr. Undersøgelser i Grønland, 1:2,000,000, Copenhagen, 1906.

In 1907 explorers again visited Independence Fjord. Mylius Erichsen and his two companions reached Cape Glacier and mapped Independence Fjord in its full extent. They spent the summer in Danmark Fjord, but in the autumn they succumbed to cold and starvation. The following year the body of Brønlund was found, together with a few sketches made by the cartographer Høeg-Hagen. The head of Independence Fjord is not indicated on the sketch maps, but there is a panorama from the head of the fiord. On the sketch two glaciers are shown descending into the inner end of the fiord. However, in lack of further information on this part of the fiord, Peary Channel was retained on the maps issued by the Danmark Expedition.

The year after the return of the Danmark Expedition a new expedition started (1910) for the same regions, and in Danmark Fjord Captain Ejnar Mikkelsen found a brief report by Mylius Erichsen. This stated that he had reached Peary's Cape Glacier on June 1 and "discovered that the Peary Channel does *not* exist; Navy Cliff is connected by fast land with Heilprin Land."[20]

Ejnar Mikkelsen did not leave any copies of Mylius Erichsen's records in the cairns. His ship was frozen into the ice, and he was compelled to spend no less than three years in eastern Greenland; and thus news of his discoveries and of Mylius Erichsen's categorical denial of the existence of the Peary Channel was withheld until 1912.

Uneasy at Ejnar Mikkelsen's prolonged absence Knud Rasmussen, accompanied by the cartographer Peter Freuchen, started in the spring of 1912 from his trading station Thule in northwestern Greenland on an expedition across the inland ice to Danmark Fjord. In Danmark Fjord he found Mylius Erichsen's cairns without any reports and proceeded to Independence Fjord in ignorance of Erichsen's discoveries and Ejnar Mikkelsen's stay in Danmark Fjord. The summer was spent in musk-ox hunting north and west of Independence Fjord. The region, including ground covered by Peary and the site of the supposed channel, was mapped by Freuchen, and Peary's report from the cairn on Navy Cliff was brought home.

Rasmussen's journey, which was successfully accomplished and had been made almost exclusively with Eskimo equipment, caused a great sensation, both as an eminent feat of sportsmanship and because the new map seemed to settle some of the questions that once more came to the fore after Ejnar Mikkelsen had brought home Mylius Erichsen's reports.[21] Immediately on his return Knud Rasmussen published a very brief report of the journey[22] and some time later a more extensive report.[23] In both these latter reports

[20] G. C. Amdrup: Mylius-Erichsen's Report on the Non-Existence of the Peary Channel; Information Brought Home by Ejnar Mikkelsen, *Meddelelser om Grønland*, Vol. 41, 1913, pp. 469–474; reference on p. 472, and "Alabama-Expeditionen til Grønlands nordøstkyst 1909–1912, Report on the Expedition by Ejnar Mikkelsen," *ibid.*, Vol. 52, 1922, pp. 1–142; reference on p. 90.

[21] An exceedingly clear and perspicuous account of the journeys is given by Captain Daniel Bruun: Peary Land landfast med Grønland, *Geogr. Tidskrift*, Vol. 22, 1913–14, pp. 85–92.

[22] *Loc. cit.*, p. 41.

[23] Knud Rasmussen: Foreløbig om "Den første Thule-Ekspedition" 1912–13, *ibid.*, pp. 183–198; *idem:* Den første Thule-Ekspedition frem og tilbage over Indlandsisen, *Ymer*, 1915, pp. 133–163.

the map is published without any attempt to explain the disagreements between Peary's original sketch and the new map.

In 1915 the final "Report of the First Thule Expedition 1912," by Knud Rasmussen and Peter Freuchen, was published in *Meddelelser om Grønland*.[24] In the text Freuchen made some reservations with regard to the correctness[25] of his map though he might have gone further and pointed out its essentially reconnaissance nature. A comparison of Figures 2 and 3 reveals the errors in Freuchen's map. This is not surprising. The work was carried out under difficulties: he was suffering to some extent from snow blindness, the instruments were not in good condition, and several long spells of bad weather were encountered.

The situation as it then stood was reviewed in the *Geographical Review* in June, 1916,[26] Freuchen's map being accepted and an attempt being made to explain Peary's conclusions. In the same year J. P. Koch's "Survey of Northeast Greenland" was published.[27] In this work Koch discussed Freuchen's map of the head of Independence Fjord[28] and tried to make it correspond with the very few observations we have left from Hagen's journey, more especially a perspective sketch from the head of Independence Fjord.

When in 1921 I traveled from the east into Independence Fjord, I carried with me the whole literature concerning the Peary Channel question. I had reached the conclusion, from what Peary had written on this subject, that there must exist a deep depression seen by him but by no one subsequently. My search for such a depression proved less difficult than I had dared to hope. When on June 7 in about longitude 28° W. I got a wide view into Brønlund Fjord, it at once struck me that the continuation of this fiord was not, as shown on Freuchen's map, a great ice cap, but that a valley or perhaps even a fiord extended far westward. The valley was so wide that I hoped by traveling through it to reach the inland ice; and for this purpose I traveled to the head of Independence Fjord, accompanied by one of my Eskimos, and thence to Brønlund Fjord. Meantime my two other Eskimos had gone there on a hunting expedition, and they told me that Brønlund Fjord was of short extent, whereas even from a rather considerable height they could not see the end of the valley. As it contained little snow, however, travel through it was impossible. Successful musk-ox hunting along the coast supplied us with sufficient provisions to enable us to map about 100 kilometers of this valley, in the interior of which there was a large low-lying lake. Later in the summer, in the middle of July, I had the opportunity of following Peary's traveling route on the ice cap to about latitude 82° N., and from this place I once more looked down on the lake. Thus I had found the large drainage territory that Peary saw, and in

[24] *Meddelelser om Grønland*, Vol. 51, 1915, pp. 283–425.
[25] *Loc. cit.*, pp. 415–418.
[26] The Non-Existence of Peary Channel, *Geogr. Rev.*, Vol. 1, 1916, pp. 448–452.
[27] *Meddelelser om Grønland*, Vol. 46, 1916, pp. 79–468.
[28] *Op. cit.*, pp. 379–392.

my opinion he was perfectly justified in taking it for a channel. This drainage area had not been observed by Knud Rasmussen and Freuchen. My discoveries in these regions I have briefly mentioned in previous articles.[29]

When now, on the basis of my map, we recapitulate the history of Peary Channel we see that the sketch Peary brought home was substantially correct with regard to almost all points in the environs of Navy Cliff, Peary's only real cartographical station during his journey; and further we see that Peary marked the drainage area as a channel. On my map we find Peary's four glaciers. Two of these descend into very low-lying lakes, the third is drained northward through Brønlund Fjord like the two first mentioned, and the fourth, first discovered by Mylius Erichsen and by him called Marie Sophie Glacier, debouches into the head of Independence Fjord. Light on the way in which Peary's mistakes arose is gained by noting that he drew the coast east of Cape Glacier in a southeastward direction. From Navy Cliff he saw what he called Academy Land. On his map we find the two small local ice caps that exist here; but, as Peary stood only at a height of 890 meters, and the mountains surrounding Cape Glacier were at least 100 meters higher, and the top of the northern ice cap another 100 meters higher, he naturally got the impression that the coast turned southeastward behind the northern ice cap, where a great valley extends in that direction. This idea was confirmed when from Navy Cliff he looked southeastward across a plateau with local ice caps and in several places far away saw land, probably situated behind Hagen's Fjord and around the head of Independence Fjord.

In conclusion I would emphasize the high quality of Peary's sketch map, and the justification for his assumption of the insularity of the land he discovered—land which now properly bears his name. Morphologically it may be regarded as an island, though it is not separated from Greenland by a channel but by a broad low depression that perhaps once after the glacial period, when the land was less high, was actually submerged.

[29] Lauge Koch: Preliminary Report on the Results of the Danish Bicentenary Expedition to North Greenland, *Geogr. Journ.*, Vol. 62, 1923, pp. 103–117, and *idem:* North of Greenland, *ibid.*, Vol. 64, 1924, pp. 6–21.

THE FIRST SIGHTING OF WEST ANTARCTICA

By Edwin Swift Balch

The Voyage of Bransfield

In the *Geographical Journal* for March, 1925 (pp. 220–225), there is an exceedingly interesting article by Lieutenant Commander R. T. Gould, R. N., "The First Sighting of the Antarctic Continent." This article is based on an account of the voyage of Edward Bransfield published in the *Literary Gazette* of November 3, 10, and 24, 1821, and which was traced a few years ago by Dr. W. S. Bruce. This is evidently much more detailed and accurate than the account published in 1821 in the *Edinburgh Philosophical Journal* which Commander Gould truly says is "of a very vague character." One of the curiosities of this article is the signature "H. M. S. Slaney." At least three writers, Dr. Fricker, Dr. Mill, and myself, in turn took it for the name of the author. Later I traced a French translation of the article and found that the author was Dr. Young of "His Majesty's Ship *Slaney*."

In the recently unearthed article in the *Literary Gazette* it is stated that from a point in latitude 63° 16′ S., longitude 60° 28′ W., at 3 P. M. on January 30, 1820, land was sighted to the "S.W." As shown on Commander Gould's map, from that point and also from the point immediately beyond where Bransfield turned east at 4 P. M. land to the southwest and trending to the eastward was in the exact position of and must have been what is now known as Trinity Island. Had Bransfield sighted the mainland, he would have said land to the south, for the mainland was south and not southwest.

Farther eastward, however, at the extreme eastern end of the peninsula, Bransfield sighted the high mountain now known as Mt. Bransfield. Apparently this was the only point on the mainland he certainly did sight. But in so doing he seems almost surely to have had the first glimpse of the mainland of West Antarctica.

In itself the voyage of Bransfield was of less importance than the voyage of William Smith, which Dr. Otto Nordenskiöld was the first to recognize as the real start of sealing and exploration in the western Antarctic. Nordenskiöld also urged seeking further information about Bransfield; and since such information has now been found, it would be a boon to all students of Antarctic discovery if the *Geographical Journal* would republish in full and verbatim the account in the *Literary Gazette*.

It is unfortunately necessary, however, to speak critically of the map accompanying the article in the *Geographical Journal*. For on this the name "Trinity Land" is marked in big letters across the northern part of the mainland.

There are no native names in the Antarctic. As a result of this, all the names in use there are those given either by explorers or by stay-at-home geographers interested in the matter. And the names adopted show clearly that the consensus of opinion is that, as far as possible, all names in the Antarctic should memorialize the discoverers, their discoveries, and their nationalities. Now the gradual unfolding and placing on the map of the lands and waters beyond latitude 60° S. are due to the explorers and

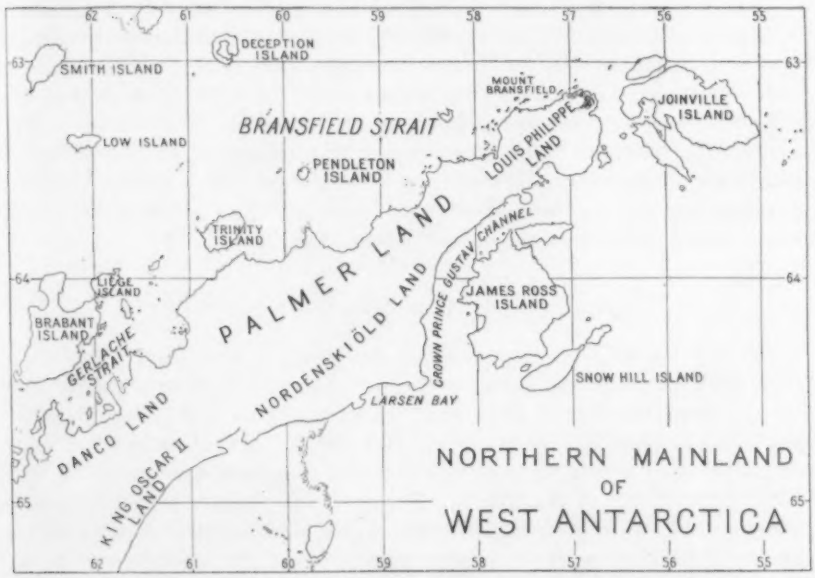

FIG. 1—Sketch map of the northern mainland of West Antarctica showing Palmer Land and Mount Bransfield.

mariners of many nations. Consequently, justice and good sportsmanship demand that credit should be given not merely to two or three explorers and nationalities but to all the explorers and nationalities that have contributed in revealing the configuration of the South Polar regions.

PALMER LAND ON THE MAP

Bransfield himself has the great memorial of "Bransfield Strait" and the lesser one of "Mt. Bransfield." The name "Trinity Land" has remained as "Trinity Island," and this is a sufficient memorial of the Trinity Board. Although Commander Gould admits there might be a difference of opinion about Bransfield's sighting the mainland, he says unqualifiedly that "part at least of Palmer Land had been previously discovered (and named 'Trinity Land')" by Bransfield. This may be true, but it may equally well not be true. For it is certainly extremely doubtful whether

Bransfield sighted any part of the mainland except Mt. Bransfield at the tip of the eastern end, which is generally known as "Louis Philippe Land."

"Palmer's Land" first appears on Laurie's Chart of November 1, 1822, as the name of the northern coast of the mainland from about longitude 57° W. to the entrance of Gerlache Strait and the northern tip of Liège Island in about longitude 62° W. This name, after many vicissitudes partly due to imperfect knowledge, has finally remained attached to it. And it is right that it should!

For "Palmer Land" memorializes the name of Nathaniel Brown Palmer, who may have been the first to sight the western part of the northern coast and who certainly was the first to recognize that it was a large mass of unbroken land. The name also memorializes the Stonington sealers and explorers, whose cruises revealed many of the secrets of the western Antarctic. To take the name away would be tantamount to destroying all memories of American discovery in West Antarctica. Justice therefore requires that the northern coast from Gerlache Strait to longitude 58° W. should continue to bear the name "Palmer Land."

The Possibility of Earlier Discovery

The tracing after so many years of the doings of Bransfield raises hopes that other forgotten data may yet come to light. Historical geographers should remember that in Herrera's "Description des Indes Occidentales," published in 1622 in French, Latin, and Dutch, there is an account of an Antarctic land which, in both position and described aspect, tallies with West Antarctica. A translation of part of the French account reads as follows: "The ship of Dirck Gerritsz, which had parted company on the 15th of September with the others, namely Wert and Cordes, was carried by the tempest down to 64° south of the Strait: where they discovered a high land with mountains covered with snow, resembling the land of Norway."

This account is too circumstantial and too accurately descriptive to be based on mere imagination. In certain respects it is analogous to Juan de la Cosa's map, which is perhaps the one positive proof of the rediscovery of North America by John Cabot. Like Juan de la Cosa's map, Herrera's account seems to record a fact, and it was so accepted at the beginning of the nineteenth century. It has since fallen rather into disrepute, however, partly because in 1899 Dr. Arthur Wichmann published two documents found by him in the Royal Archives at The Hague, documents which I examined later and whereof I had copies made. One of these documents states that Dirck Gerritsz went to latitude 56° S. and therefore could not have seen West Antarctica. The other document, which does not mention an Antarctic land, tells however of a ship under Don Gabriel de Castiglio, which in 1603 did reach latitude 64° S. where they had a great deal of snow.

Granting now that Dirck Gerritsz was mistakenly assumed to be the discoverer of land in 64° south of Cape Horn, yet, when we consider that one ship is recorded as having reached latitude 64° S. in 1603 and that in 1622 there was published an account of a land in latitude 64° S. answering in all respects to West Antarctica, it is almost certain that some one sighted it over three hundred years ago. I wrote to this effect in 1902 in "Antarctica." The finding of the Bransfield records renews my hopes that still buried records may some day be found, perhaps in Spanish archives, about this forgotten seventeenth century mariner. But whether his name is ever traced or not, it is my firm belief that before the year 1622 some one sighted at least one of the islands of the land mass of West Antarctica.

GEOGRAPHICAL RECORD

NORTH AMERICA

The Discovery of Aniakchak Crater, Alaska. In 1922, while engaged in reconnaissance survey on the Alaska Peninsula west of the Aleutian Range, R. H. Sargent and Walter R. Smith of the U. S. Geological Survey discovered a gigantic crater which they named Aniakchak from the river taking its source therein. The crater lies just west of the 158th meridian and south of the 57th parallel. It is about a hundred and fifty miles southwest of Katmai, which it appears to resemble in origin but far surpasses in size. In shape and magnitude it compares with Crater Lake. The circumference is 19 miles, the minimum diameter a little less than 6 miles, the maximum diameter 6¾ miles (the maximum diameter of Katmai is 3 miles). From the lowest point on the floor, 1000 feet altitude, to the highest crest of the rim the difference of elevation is 3200 feet. The average height of the crater walls is 1600 feet, although in places they reach 2000 feet. A black truncated cinder cone rises 2200 feet above the floor of the crater, and there are several mud cones from 200 to 300 feet in height. A beautiful lake 2½ miles long, named Surprise Lake, occupies the extreme northeastern portion of the amphitheater. From it the Aniakchak River, here a stream 75 feet wide and 3 feet deep, plunges down a rather steep bed and breaks through the southeastern portion of the rim in a picturesque gorge, the "Gates."

The valleys of the surrounding country for many miles are covered by thick deposits of ejecta from the crater, fine ash, fragments of black and pink lava, and gray, black, and red pumice. Vegetation has gained a footing in places, but large areas within a radius of twenty miles from the crater are entirely barren of plant life and have the appearance of arid plains.

All the evidence available indicates that this great crater was formed by explosion and not by subsidence, as is considered the explanation of all known craters of similar size, Crater Lake for instance. Sufficient data on which to base an estimate of the date of eruption were not collected, but the consolidated material in some of the valleys and the amount of stream erosion suggest that it is one of the oldest of the series of volcanoes along the Aleutian Range and that the eruption antedates historic record.

Mr. Smith's account of the crater, published as *U. S. Geological Survey Professional Paper 132 J*, 1925, includes a relief map of the crater and vicinity and a striking panorama looking across the cinder cone and lake.

Materials for the Geographical Study of American Ports. A collection of documents dealing with the ports of the United States is now being published by the Corps of Engineers of the U. S. Army and the U. S. Shipping Board. The material in this "Port Series" will provide American students with a starting point for studies of the geography of ports comparable to the excellent investigations in this field being carried on by the French (see Albert Demangeon: The Port of Paris, *Geogr. Rev.*, Vol. 10, 1920, pp. 277–296). Each volume contains, in the first place, a variety of data covering local conditions, such as topography, tides, weather, health, bridges, terminal facilities, customs regulations, pilotage, wharfage, lighterage, labor, fuel, supplies, communications, etc. This is followed by discussions and statistics regarding the commerce of the port and the various factors that affect this commerce, both natural (such as relative distances) and artificial (such as railway freight rates). The volumes are illustrated with airplane views, photo-

graphs, maps, and cartograms showing the ports themselves, the interior territories served by them, and the extent of their commerce. Five volumes have been published to date: No. 1, Portland, Me., 1921; No. 2, Boston, Mass., 1922; No. 3, Mobile, Ala., and Pensacola, Fla., 1922; No. 4, Philadelphia, Pa. (including Camden, N. J., Chester, Pa., and Wilmington, Del.), 1922; No. 5, New Orleans, La., 1924.

Geographical conditions adverse to the development of a port may often be neutralized by the handiwork of man, either by physical improvements of the harbor and its facilities or by the granting of freight differentials and similar transportation privileges. Unfortunately the reverse is also sometimes possible—the erection of artificial obstacles in the way of the growth of a port otherwise favored geographically.

A striking example of natural disadvantages in a port is offered at New Orleans. The sliding of the banks along the Mississippi has "caused practically all of the longitudinal wharf structures to push outward more or less, and wharves have actually given way completely, practically without warning. The existing development consists primarily of a succession of covered wharves paralleling the river bank." Owing to the treacherous foundations upon which these wharves are built, it has been necessary to place the railway tracks "entirely in the rear of the sheds, thus necessitating the unloading of practically all railroad freight at the rear of the sheds, and its transportation by longshoremen across the entire width of the wharves to ship side." This has resulted in the loss of "many shipments [especially of heavy commodities such as machinery] which might otherwise have been routed advantageously through the port." The construction of slips communicating with the canal recently built between the Mississippi and Lake Pontchartrain and of ship-side warehouses along its banks ought ultimately to do away with this difficulty.

A case where artificial factors have neutralized natural advantages is provided at Portland, Me. While Portland serves primarily as a winter outlet for Canadian grain, its fine harbor and central position would seem to make it the logical port of northern New England. It does not, however, enjoy this status. "The failure of Portland to attract trade from and to the territory which might be considered geographically tributary to it is due to a number of causes, but the most important cause is the lack of facilities for handling such traffic," facilities which the railroads seem unwilling to provide. "While the interests of the shipper in many cases would be best served by the utilization of the shortest rail haul, the interests of the railroads are often better served by compelling traffic to find its outlet through a port involving a longer haul." This explains largely why "the principal movement of export traffic from New England is through [neither Boston nor Portland but through] the port of New York."

The Temperature of Ground and Surface Waters in the United States. The temperature of ground and surface waters is a fact of importance in relation to the industrial use of these waters. The matter is discussed by W. D. Collins in *U. S. Geol. Survey Water-Supply Paper 520–F*, Washington, 1925.

The temperature of non-thermal ground water below a depth of 30 feet is, broadly speaking, unvariable, being practically uninfluenced by atmospheric seasonal changes. From 20 to 200 feet below the surface this temperature usually stands from 3° to 6° F. higher than the mean annual temperature of the atmosphere. Therefore, on the basis of the isothermal maps showing the latter, it is possible to construct fairly accurate maps of the approximate ground water temperatures. Such a map for the United States accompanies Mr. Collins' paper.

The temperature of the surface water in lakes and rivers, on the other hand, varies with the seasons, corresponding in a general way to the monthly mean temperature of the air. During the spring and early summer the water temperature is usually a

few degrees cooler than that of the air. "On the average the water temperature will be within 3° above or below the mean monthly air temperature in July and from 2° to 5° above the mean in August." During the autumn months the water cools throughout most of the United States until it reaches the minimum of 32° to 34°; it does not, however, cool as rapidly as the air, maintaining an average temperature a few degrees higher than that of the monthly mean atmospheric temperature.

Several interesting exceptions to the generally applicable rule are noted. "Mountain streams, which may be formed largely from melting snow and may flow quickly into plains where the temperature is high, will have a temperature much below the mean monthly air temperature in the plains." The Mississippi River, coming in winter and spring from a colder region to the north, maintains a temperature much colder normally than the atmosphere at New Orleans. During July, August, and September, on the other hand, when the Mississippi valley experiences almost as warm weather throughout its entire extent as that which prevails at New Orleans, the river water at New Orleans is as warm as and warmer than the air. At Youngstown, Ohio, we have the anomalous condition of river water throughout the year maintaining a considerably higher temperature than that of the air. This "results from the use of the water for cooling at industrial plants above Youngstown," a process which raises the temperature some 20° in summer.

FIG. 1—Distribution of rural house types in Argentina. From the map accompanying Dr. Kühn's paper. 1, walls of brick; 2, of mud; 3, of branches; 4, of adobe; 5, of stone (*pirca*); 6, of wooden stakes; 7, of wooden boards; 8, Araucanian houses; 9, roof of palm shingles.

SOUTH AMERICA

Rural Habitations in Argentina. "Ecogeografía" has received little attention in Argentina. Ecogeografía is Dr. Francisco Kühn's equivalent of the German "Siedelungskunde," what the French call the study of "établissements humaines," for which no precise term seems to exist in English. The possibilities for such study in Argentina are indicated by Dr. Kühn in a paper entitled "Material de observación para la ecogeografía argentina: Algunos tipos de viviendas rurales" (*Univ. Nacl. de Buenos Aires, Publ. del Inst. de Investigaciones Geogr. No. 8*, 1924).

In his introduction Dr. Kühn makes the prime distinction into nomad and sedentary habitations. Today the former, at least that of primitive type, is to be met with only in the extreme north and south of the country, in the Chaco and Fuegia. A modern form, however, may be said to obtain on the pampas where the agricultural colonist occupying land on a short-term contract too often lives in a wretched temporary hovel. The sedentary habitation is a good index to the state of civilization of a country. The rural dwellings of Argentina in general are characterized by uniformity, primitiveness, and lack of both adornment and convenience. The climate plays its part: commonly the habitation merely provides shelter for eating and sleeping in a life passed essentially in the open.

Dr. Kühn discusses in some detail the habitations of two regions, the arid mountains of the northwest and the wooded zone of the Patagonian cordillera. In the former are two main types in sympathy with two valley types. The structural valleys, *bolsóns*, with an alluvial fill supply material for the walls of the adobe house. The framework is often of algarrobo wood. The roof of single or double pitch and sometimes projected to form a veranda is covered with cane or reeds. The houses of the *estancias* are of the same type as the isolated farm huts but of superior construction, and very similar houses are found in the small isolated towns. Dr. Kühn notes an interesting exception in the Diamante valley of Mendoza. Where the river flows in a deep-sunk bed across the semidesert of the Pampa de Diamante the houses are built entirely of boulders from the stream with a fine argillaceous sand used as mortar.

In the lateral *quebradas* stone is the only material available for the house walls. Here we have the *pirca*, a pre-Hispanic type, of undressed stone laid without mortar. The roof is turf covered on a frame of cactus, the only local building wood, though in some districts not far from the borders of the subtropical forest bamboo is procured. The *pirca* varies considerably in merit. The inferior forms, often very low structures, are found in the remotest spots. In the superior the single structure has been differentiated into dwelling, kitchen, and storehouse enclosing a patio. Furniture, however, is still lacking; the occupants sleep on the ground.

On the arid Patagonian plains all building material is imported. Westward, however, we come to the wooded zone of the cordillera. Here the houses of the colonists and *estancieros* are of local timber in European style. The huts of the aboriginals are on traditional lines. Three main forms may be distinguished according as the huts are built entirely of bamboo, of logs with bamboo roof, or of solid timber roof. The last is found in the very scantily populated zone of thick wet woods of the Chilean type where excellent material is available and the climate calls for substantial structures.

Chilean Port Development. Until recently the west coast ports of South America have been of two classes—open roadsteads and unimproved natural harbors. In the case of the former shipping was so completely unprotected from wind and current that, except at times of comparative calm, unloading of both passengers and freight was difficult and often dangerous. In the case of the latter shipping was protected from winds from certain directions but was not only completely exposed to winds from other directions but was in even greater danger than at the open roadsteads because of the various effects of the configuration of the harbor on the direction and force of waves and currents. At Valparaiso, for instance, where the bay protects shipping on the south and east, the harbor opens to the north and northwest and the Commission of Ports of Chile has found that in building a breakwater to protect the harbor from storms from these directions protection must be provided against storm waves that rise to six, eight, and in exceptional cases, twelve meters in height. In both the roadsteads and the natural harbors ships have to anchor at some distance from the shore, and freight must be transferred to the shore by means of lighters—a laborious and costly system even in good weather.

Throughout the west coast countries the extensive exploitation of mineral resources made possible by the Panama Canal and the consequent increase in the demand for American and European manufactures have so increased the shipping at certain ports that the necessity of improving facilities for speedy loading and unloading of ships is everywhere seen as a vital problem. This is particularly the case in Chile, not only on account of local development of mineral and agricultural resources but also because of the international railways in actual operation or projected with termini in Chilean ports. The Chilean government has responded with a program of port development which is being rapidly carried out (see Eduardo

Reyes Cox: The Ports of Chile: Works of Improvement, *Bull. Pan-Amer. Union*, Washington, Vol. 59, 1925, pp. 115–133).

In order of importance as established by the Commission of Ports created by Federal law in 1910, the following ports have been declared as in most immediate need of development: Valparaiso, Antofagasta, Arica, Talcahuano, Lebu, and Valdivia. At Valparaiso the development work begun in 1912 is now almost completed except for one section of the breakwater for which the contract has recently been let. The development includes 1000 meters of breakwater, over 2500 meters of dock space, and loading and unloading equipment of the most modern type. At San Antonio, the port auxiliary to Valparaiso, the improvement work is finished. At Antofagasta, Pacific coast terminus of the Antofagasta and Bolivia railway and shipping port for the copper region of northern Chile as well as for a large section of the nitrate region, work is well under way. At Valdivia, which will be the Pacific coast terminus of the proposed railroad to San Antonio, Argentina, the construction of embankments on the Valdivia River and stone dikes to prevent the formation of sand bars has been completed. At Constitución, port of an important agricultural district, dikes on the Maule River and an anteport protected by jetties and connected by canal with an inner port on the river are under construction. At Lebu, port of the coal region of south-central Chile and now being connected with Los Sauces by a railway which it is planned to extend to meet the Argentine railway under construction from Bahía Blanca to Lonquimai, improvement work is planned similar to that at Constitución. Bids are now being called for for the construction of jetties and docks at Arica, Pacific coast terminus of the Arica-La Paz railway.

Similar projects are being considered in the other west coast countries. At Buenaventura, which, with the completion of the Pacific railway from Ibagué, will rise to the position of a major Pacific port, one concrete wharf has been built, and the dredging of the harbor and the diking of the mouth of the Dagua River are planned. The plans for the Quito-Esmeraldas railway provide for harbor improvements at San Lorenzo. The project for a railway from Quito to Bahía de Caraques includes plans for breakwaters and docks.

EUROPE

The Place Names of France. À propos of the posthumous publication now in progress of Auguste Longnon's monumental work, "Les noms de lieu de la France," Albert Dauzat contributes a short but informative article to *La Nature* for May 9, 1925, pp. 289–293. He shows that the study of European place names cannot be attempted by anyone without a thorough grounding in linguistics. On the other hand an historical and geographical background for researches in this field is of almost equal importance: "Longnon luimême ne vint à la linguistique qu'à travers la géographie et l'histoire."

The place names of France were established essentially in their present form by the thirteenth century. They seem to have been derived from four principal sources: (1) the pre-Celtic inhabitants of France; (2) the Celts; (3) the Romans, and (4) the Teutonic invaders. The names of the more important rivers, Seine, Loire, Garonne, Rhône, Allier, and Meuse, are all of pre-Celtic origin. Some of the pre-Celtic names, particularly in the Alpine region, may have come from the Ligurian, an obscure Indo-European tongue about which little is known. Celtic and Latin names are widely distributed, the latter being particularly numerous in the south; the Teutonic element is especially well represented in Normandy.

Most European place names were first derived either from natural features or from works of man, or else were given in honor of some individual. The religious life of the Middle Ages produced a quantity of variants of the Latin *basilica* (church)

and *monasterium* (monastery), such as: Bazauges, Basouges, Bazoches, Moutiers, Montier, Monestier, Montrieul, Montereau, Monistrol, etc., and many localities are named after saints. The laws governing the transformation of names vary with local dialects; thus the Latin *fabrica* becomes Fabrègue in Provence, Fargue in the southwest, Farge in Auvergne and Limousin, Faverge in Savoy, Forge in *langue d'oïl*. Many names are transformed through false analogies and popular etymologies and not infrequently through copyists' errors on charters and other documents and on maps.

If correctly understood and properly interpreted, place names may give a clue to historical geography. They sometimes show the areas formerly occupied but subsequently abandoned by a tribe or people. The evidence from place names, for instance, indicates that the Norse colonization of Normandy was less dense in the south than in the north, an inference confirmed by historical records and by the distribution of types of rural habitation. Occasionally toponymy may even furnish the sole clue to prehistoric racial habitats.

AFRICA

Dakar, An Imperial City. A sandy beach, silent, deserted; native huts and some few European business houses, ill-defined streets, choked with sand; the rocky islet of Gorée with its dismantled fort and ruined houses; bare red crests of the "monts du Cap Verd"; to eastward a stretch of dull gray coast relieved only by an occasional palm; laterite and aridity the dominant features of the landscape. This is Camille Guy's picture of Dakar at the beginning of the century when the settlement numbered half a hundred whites and two to three thousand natives and steamers called at the port twice a month (Dakar ville impériale, *L'Afrique Française*, Vol. 34, 1924, pp. 580–586). Today Dakar has 3000 Europeans and 27,000 natives; the improved port cannot accommodate the number of large vessels that call, and further works are under consideration.

This progress is not surprising. Dakar occupies a strategic situation, the most westerly point of Africa, the point nearest South America; it is a port of call for ships sailing along the west African coast and from Europe to South America, and now enters into successful competition with the ports of the Canaries. Furthermore, Dakar lies on the northern boundary of the Sudan and thus is a mercantile port for a great and growing hinterland. At present two railway lines serve the port—from St. Louis and from Kayes, the latter 1200 kilometers long. Dakar already is known for its important wireless station and has before it a future as an aviation station. The establishment of aerial lines between France and French West Africa and South America is again being discussed in France. Doubtless the final achievement is remote, but Henry Hubert gives some practical plans for the portion of the route between Port Étienne, the most northerly point of French West Africa, and Dakar, 700 kilometers in air line (La sécurité de la navigation aérienne entre Port-Étienne et Dakar, *Bull. Comité d'Études Hist. et Sci. de l'Afrique Occidentale Française*, Vol. 8, 1925, pp. 9–56).

The chief handicaps to the growth of Dakar have lain in the lack of water and local resources. The town is now supplied with water from some distance by conduit, and another conduit is under construction. Wells have been sunk and water vegetable gardens whose product is sufficient not only to provision the inhabitants but to supply passing ships. An oil depot to hold 20,000 tons is being added to the coal depot.

The latest event in the history of the town is the clearing up of a somewhat anomalous political situation. Dakar is capital of the eight colonies that compose French West Africa, but it was situated in Senegal which has its own capital in

St. Louis. By decree of October, 1924, the communes of Dakar and Gorée with an adjacent area containing the springs that aliment the town is created an autonomous territory. Thus, says M. Guy, Dakar becomes truly an imperial city, *urbs*, in the Latin sense of the word.

An Aerial Survey of Dakar. In the *Bulletin du Comité d'Études Historiques et Scientifiques de l'Afrique Occidentale Francaise* (No. 1, 1923) there is an interesting and lucid account of how the recently published map (1:10,000) of the Dakar peninsula was made. This account is particularly noteworthy as new methods were employed and as the results, excellently reproduced, seem to be cartographically all that could be desired.

Three previous triangulations of the area were used in conjunction together to form the major control. The whole area, about 32 square miles, was then photographed from the air in flights totaling only 6 hours in duration. The overlap of photographs was, however, very uneven and less than 30 per cent. A plane table triangulation was also made in order that sufficient control points might be available on each photograph. The method of transferring the required topographical detail onto "la feuille de projection" consisted first of all in the identification and accentuation on the photographs of the details required. These were determined by a stereoscopic examination or, in the case of town areas and where there was much topographical detail, by examination of photographs taken at a lower altitude. These accentuated photographs were then rephotographed by a method very similar to M. Roussilhe's now well-known method of "photo-restitution" so that all appreciable distortion due to tilt and inequalities of scale was eliminated. The survey was fortunate in not having to contend, except in one instance, with differences of altitude exceeding 40 meters. The now undistorted topography was then transferred direct to the working copy of the map.

The result was "une carte muette," which phrase aptly calls attention to a point which is often forgotten in extolling the merits of aerial surveying. Consequently, a further reconnaissance was made in order to supply place names, etc.

Owing to the fact that natural objects easily identifiable were, for the most part, chosen as control points and that the survey was able to use previously executed triangulation, the whole work was accomplished with speed and economy. In respect to time, experience showed that an aerial survey shortens the field work to such an extent that it more than counterbalances the increased time taken in drawing the map in the office.

It is worthy of note that no difficulty was experienced in flying at a sufficiently constant altitude and that distortion errors were nearly all due to tilt. This tilt of the camera was almost a constant, varying very little from one consecutive photograph to the next.

ASIA

The Glaciers of Turkestan. In articles published since the Revolution, Russian geographers present a considerable amount of new information concerning the glaciers of this still little-known region, to which American and Western European authorities have lately also given a great deal of attention. The most important of recent explorations by foreign scholars was the Pamir-Alai expedition of the German and Austrian Alpine Society in 1913, reported by W. Rickmer Rickmers and R. von Klebelsberg in the Society's *Zeitschrift* for 1914 (Vol. 45, pp. 1–60) and by Rickmers in the *Geographical Journal* for December, 1913 (Vol. 42, p. 570), and February, 1914 (Vol. 43, pp. 182–184). An expedition in 1914 of Fritz Machatschek, one of the foremost authorities on the region, was not primarily for the study of its glaciers

(see accounts by him in *Zeitschr. Gesell. für Erdkunde zu Berlin*, 1915, pp. 155–170, and *Mitt. K. K. Geogr. Gesell. in Wien*, Vol. 58, 1915, pp. 350–399).

The further observations of Russian scholars accord with previous studies in the conclusion that the glaciation of Turkestan is predominantly of the "valley (or Himalayan) type" in its strictest sense, the elongated main *névé* being fed by tributary ice streams. The large glaciers still in existence are of this type, and the smaller ones are derivative forms left by the disappearance of such glaciers existing in the past—cirque glaciers, hanging glaciers, etc. A number of examples of all these forms are described by D. I. Mushketov in the *Izvestia* of the Russian Geographical Society for 1917 (Vol. 53, pp. 83–136) in an article covering his studies during the preceding six years of the glaciers of eastern Ferghana and the Alai valley. V. A. Nikolaev, who describes the glaciation of the Dzungarian Ala-tau in the *Izvestia* of the Geographical Institute for 1923 (Part IV, pp. 32–38), found there only residual cirque and hanging glaciers on the slopes with northward exposures. In the western Kunlun Mountains, the glaciation of which is described by G. Sobolevski in the Geographical Society's *Izvestia* for 1918 (Vol. 54, pp. 27–56), practically no active vestiges of true valley glaciation remain. These mountains were long supposed to be entirely without present glacial activity; but on the northern slopes above a series of abandoned cirques are found small, irregular hanging glaciers without proper *névés*, descending directly from the lofty snow line. They terminate at much higher altitudes than the glaciers of other parts of Turkestan—an average of 4370 meters, as compared with about 3500 meters in the Alai and the Ala-tau. These characteristics are attributed by Sobolevski to the scarcity of moisture in the district, isolated by higher ranges, and to the uncommon steepness of the slopes.

One of the greatest glaciers of Turkestan, the Garmo in the Darvaz highland of eastern Bukhara, hitherto unexplored except for a passing visit of the Rickmers party, is described by I. I. Beliaev and P. I. Besedin in the 1923 number of the same publication (Vol. 55, pp. 1–123). Although both explorers had other aims in view and confess to a lack of competence in glaciology, they present a sufficiently striking picture of a magnificent ramified valley glacier. The Garmo forms one of a knot of mighty glaciers radiating south of the Peter the Great Range into the valleys of the Khingou and Vanch Rivers and north of it into the valley of the Muk-su. Their upper limits remain inadequately explored, but stories current among the native Tadziks of passages made from one to another give ground for conjectures as to the existence of practicable cols across the main divide. Beliaev, however, failed to find any such passage from the Garmo glacier, which lies on the southern slope. He was likewise unable to get any definite information about a pass at the head of the neighboring Kashal-aiak glacier, in the Vanch valley, which he had not enough resources remaining to explore. N. L. Korzhenevski, who, in the *Izvestia* of the Geographical Society's Turkestan Section for 1922 (Vol. 15, pp. 23–27), describes the Fedchenko (Sel-dara) and Mushketov (Kara-sel) glaciers of the Muk-su valley, supposes an actual coalescence of the *névé* of the former with that of the Kashal-aiak across the divide. The Fedchenko glacier, characterized by this writer as approaching the "expanded foot" type, is also described in Mushketov's article as debouching peculiarly, a mass of clear ice without terminal moraine, directly into an alluvial valley.

Korzhenevski's observations, made in 1914, of the two glaciers with which he deals showed notable changes from conditions recorded by him in 1904 and 1910. In both cases the ice had greatly increased in volume, filling up and pushing forward into the valleys. An earlier observer's record is cited of a similar advance noted in 1878, indicating a correspondence with the contemporary behavior of Alpine glaciers. In contrast to this glacial advance in Turkestan, however, is to be noted a report by P. Tsirulnikov in the parent Society's *Izvestia* for 1917 (Vol. 53, pp. 45–55) of obser-

vations of several glaciers in the Caucasus, showing a consistent recession, averaging several rods a year, over a period of years preceding 1914 and 1915.

On all the mountain slopes of Turkestan are found traces of earlier glaciation on a far grander scale than the present, though still of the isolated valley type, indicating no extensive ice sheet. Mushketov presents comparative measurements of the altitudes of existing termini and older terminal moraines in the cases of thirty-seven glaciers in the districts with which he deals. While the absolute figures vary considerably, the ratios are fairly constant, showing an average difference of altitude between present and lowermost former termini of about 1000 meters. In about half the cases, moreover, measurements are given for a distinct intermediate moraine; while, in some, observations are recorded of still others. The general conclusions emerging from these data are thus in accord with those reached by Ellsworth Huntington in his "A Geologic and Physiographic Reconnaissance in Central Turkestan," published among the accounts of the Pumpelly expedition of 1903 by the Carnegie Institution (Washington, 1905): namely, that they show the former existence of at least two major glacial epochs, separated by warmer periods. While Huntington believes he has some ground for increasing the number to five, Mushketov contents himself with the supposition of two phases of advance in the second epoch. Nikolaev's observations in the Ala-tau yield similar results, as do those of Sobolevski in the Kunlun. The investigation of remains of former glaciation in the latter district is rendered especially difficult by the severity of subsequent erosion and the obscuring of all characteristic features under a heavy deposit of wind-blown loess; yet sufficient evidence was found of the existence of two separate epochs. The limit of even the greatest former advance was fixed at a much higher altitude than in other districts of Turkestan—relatively higher (3600 meters, as compared with 2500 meters) than the present limit. The distance between present and lowermost former termini averages less than 700 meters.

In connection with these glacial records of Turkestan, attention may be called to an article following Sobolevski's (same publication, pp. 56–100) describing traces of former glacial action in northeastern Mongolia, encountered by the geological expedition of M. A. Usov in 1914–1915. The glacial development in this region, as in Turkestan, appears to have been confined to the formation of separate glaciers, rather than of an ice sheet. The observations were too scanty and scattering to permit of any clear deductions as to the number of epochs of advance.

J. V. FULLER

AUSTRALASIA AND OCEANIA

The Site and Position of Sydney in Relation to Population. The accompanying map, Figure 1, shows the singular disposition of population around Sydney, Australia's largest city, now numbering a million people. It is reproduced from a paper by Griffith Taylor, "The Warped Littoral Around Sydney" (*Journ. and Proc. Royal Soc. of New South Wales*, Vol. 57, Part I, 1923, pp. 58–79). Dr. Taylor describes the distribution as viewed from an airplane circling the city on a 50-mile radius. "On the north our flight leaves the narrow coastal plain at Wyee. Thereafter for eighty miles along our circle we cross only one good road. . . . The next twenty miles crosses Bell's road . . . and brings us to the Katoomba tourist belt. Proceeding south for forty miles we notice the single settlement of the Yerranderie mines, before we reach the southern [railway] line near Balmoral. Another twenty miles stretch of uninhabited water reserves brings us to the narrow coast plain near Kiama, and here again a closely settled region is observed. Thus, excluding the shore, during a flight of over 150 miles, we have only crossed two narrow belts of settlement." Also striking is the symmetry of distribution about

an east-west axis. Explanation is to be found in the physical history of the region, which Dr. Taylor illustrates with orographical and geological sketch maps, a map of geographical regions, and a block diagram. The last is reproduced as Figure 1.

The block diagram exhibits the notable symmetry about an axis running west from Botany Bay. Botany Bay, a drowned circular plain, is unlike any of the

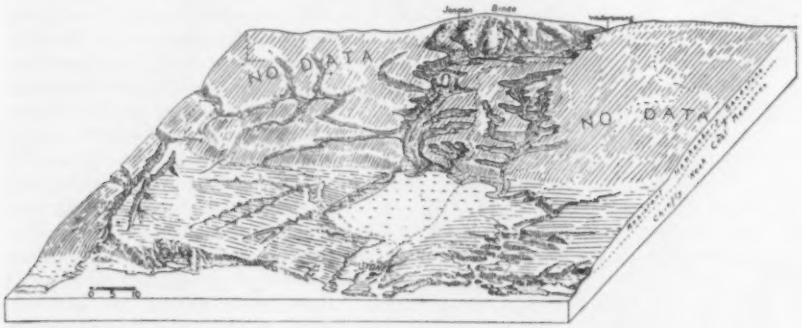

FIG. 1

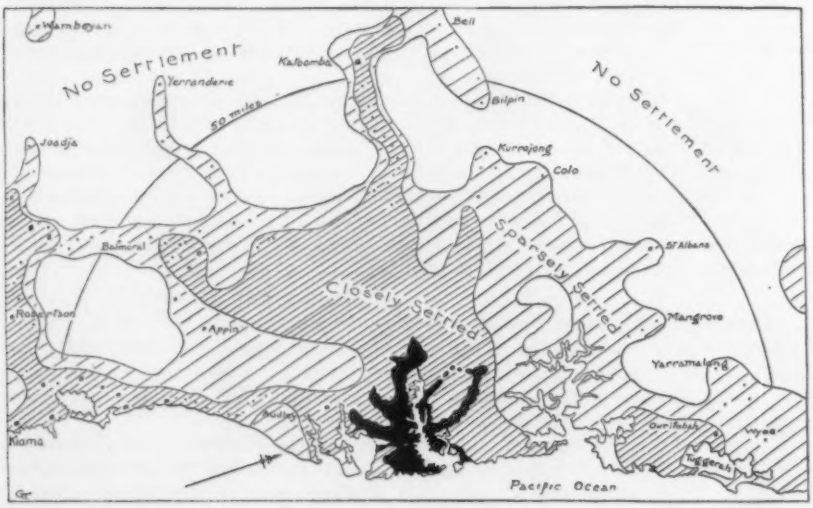

FIG. 2

FIG. 1—Block diagram of the warped littoral about Sydney, looking west. Reproduced from Figure 3 of Dr. Taylor's paper.

FIG. 2—Distribution of settlement about Sydney. Region of city streets black; region where centers are less than four miles apart closely ruled. (The arc is 50 miles radius.) From Figure 5 of Dr. Taylor's paper.

adjoining inlets. Previous to depression this area and the Wianamatta plains to the westward had not participated in the dominant movement of elevation which affected almost all the littoral. The Wianamatta plains is a gently rolling country developed on soft shales, moderately fertile and offering opportunity for close settlement. All around resistant and sterile sandstones constitute a barrier between Sydney and the interior.

Sydney itself occupies a hilly site. The city, especially the mercantile city, has spread along the little-warped south shore; the residential section tends to the northern, more elevated shore. The site is undoubtedly the best in the vicinity. Botany Bay does not have the facilities for deep water frontage, and Port Hacking, the estuary corresponding to Port Jackson south of the axis of symmetry, is shoaled by silt from numerous streams. Port Jackson also penetrates farthest into the plains area. Though Sydney is handicapped by the landward barriers it is favored in other respects of situation, as Mr. M. Aurousseau has described in an "interpretation" of Sydney in the *Sydney Morning Herald* (Dec. 20 and 27, 1924, and Jan. 3, 10, and 17, 1925). "Sydney is at a point that is suited to the distribution of population in eastern Australia, from Townsville to Melbourne; a point that has the character of a mathematical mean. It is near the middle point of the coast of New South Wales, and can receive with maximum efficiency from the minor ports to north and south. It is on a stretch of coast that is nearer to New Zealand than any other part of Australia but Hobart, and nearest to that part of New Zealand that has the most important dealings with the Pacific. It is a more suitable rendezvous for trade with the arc of islands from New Guinea to New Zealand than any place further north. This is due in part to the existence of the Barrier Reef, which impedes the decentralisation of island traffic, but in greater part to the fact that no place on the coast of Queensland has the other advantages of site and position that Sydney possesses. It is also on a great marine highway, the road from the Far East to Melbourne, and is the best terminus for American traffic. The position to seaward, then, is a splendid one. To landward it is not so good. The emplacement of Sydney is somewhat analogous to that of Rio de Janeiro, the superb gateway of a rugged and difficult hinterland."

The chief rival to Sydney is likely to arise in the north of the state, where industrial development is already foreshadowed in the Newcastle coal fields. Newcastle has the advantage of the best route to the interior, but the site is inferior to that of Sydney. Mr. Aurousseau points out "an unsuspected advantage of position" in that Sydney lies at the center of a semicircle about which are three coal fields—Newcastle, Lithgow, and Kembla—and thus within a ring of future industry. Here is another circumstance pointing to the evolution of Sydney not only as capital and commercial city but as a true metropolis.

Australian Problems in Human and Physical Geography. Mr. J. V. Daneš, professor of geography at the Charles University of Prague, Czechoslovakia, has returned from Australia, the scene of some of his earlier studies and where he has lately been acting as Consul General for his country. The results of his recent investigations are now being published.

In a paper entitled "Origin and Extinction of the Aboriginals of Australia" (*Země a lidé*, Vol. 50, Prague, 1924) Mr. Daneš approaches the problem of the origin of the aboriginal population from a morphological and paleogeographic standpoint. In accord with Griffith Taylor he thinks it probable that the Tasmanians crossed to Australia during the third or penultimate glaciation, the Australian aboriginals during the last one. Glaciation had ended and Bass Strait opened again before the latter had been able to reach southeastern Australia, hence the preservation of the Tasmanians on their island. The movements of these primitive paleolithic tribes is to be explained by the very different configuration of the land at the time of their migrations.

The author accepts Daly's views as regards the lowering of the ocean level during each glaciation by the accumulation of water in the form of ice on the continents ("The Eustatical Sinking of the Sea Level During the Glacial Epoch and the Distribution of Men," *Sborník československé společnosti zeměpisné*, Vol. 30, Prague, 1924). In assuming a lowering of sea level of about 60 or 80 meters at the

time of maximum of each glaciation land bridges would come into existence for the time being. Australia would be connected with New Guinea and Tasmania. At the same time the Asiatic continent would embrace Molengraaff's Sundaland, Sumatra, Java, and Borneo. Deep passages would still occur between the lesser Sunda Islands, Celebes, the Moluccas, and the western peninsula of New Guinea, but they are in a region of tectonic unrest and may well have come into existence only after the human migration.

The one great obstacle against the assumption of such a land connection is the profound difference between the Asiatic and Australian faunas. But it may be noted that mobile creatures, such as the dingo, certain mice, and man himself could avail themselves of the supposed bridges during a time too short for slower migrating forms. Furthermore, climatic conditions were then quite different. Following Penck's theory of the equatorward shifting of the climatic zones during glaciation, Daneš attributes desert conditions to the short-lived bridges between Asia and Australia.

Daneš also suggests that the many gaps in the prehistoric record point to a recent rise of sea level. Primitive man found most favorable living conditions along the seashores and river mouths. It is significant that kitchen middens are found only in regions of recent uplift. Rise of sea level would drown traces of such occupation, and on coasts with heavy tides and strong sedimentation it would seem hopeless to find them. Exceptionally favorable conditions, however, would appear to occur along the Dinaric shores of the Adriatic. There are practically no tides; the rivers from the karst carry practically no waste; cold submarine springs prevent the development of a rich marine life. At the same time these calciferous waters precipitate travertine, encrusting such remains as lie on the present sea floor. The transparent waters of the Adriatic permit observations to be made from the surface, and it is here that conditions would seem most favorable for solving the enigma of man during the Ice Age.

JULIE MOSCHELES

POLAR REGIONS

The Amundsen-Ellsworth Polar Flight. The Amundsen-Ellsworth Polar Expedition returned safely to Spitsbergen on June 18 after a month's absence. The plans of the expedition were briefly described by Mr. Ellsworth in the April number of the *Geographical Review*. Meteorological conditions were naturally of prime importance and the careful preparations included analysis of weather reports received from the regions circling the Arctic by the younger Bjerknes and another Norwegian meteorologist. On their advice the flight began May 21, the planes taking off from the base at King's Bay at 5 P. M. An hour later fog was encountered and the planes rose to a height of 3100 feet and met a stiff breeze from the northeast. Through rifts in the fog glimpses were had of the polar pack, reached in 2 hours of flying time. At 8 P. M. the fliers passed out of the fog to see spread below them "a spectacular sheet of snow and ice" everywhere marked by heavy pressure ridges. Thenceforth conditions of visibility were excellent. An observation at 10 P. M. showed the wind had carried the fliers too far westward. At 1 A. M. half the gasoline had been used. The planes were then above a large lead, the first of any size seen, and the only suitable landing place amid the jagged ice. Descent was made for bearings. The N25 was immediately locked in by two masses of ice, and in a short time the N24 was also gripped. The position was latitude 87° 44′ N. and longitude approximately 10° 21′ W. On the flight 1000 kilometers (611 miles) had been covered in 8 hours at an average speed of 150 kilometers (93 miles) an hour, the headwind thus having held back the planes 200 kilometers.

At this point the expedition was 300 miles from Greenland, 450 miles from Cape Columbia. It was judged that the best hope lay with the planes, but in the event of being unable to get off it was decided to attempt the journey on foot to Columbia rather than the inhospitable Greenlandic coast. With rations cut down to a minimum the six members of the expedition set themselves to the task of releasing the N25 and preparing a runway, a task rendered extremely difficult by the movements of the ice. Five attempts failed. It took a week to clear 500 yards on the floe, from which the sixth and successful attempt was made. Temperature conditions also were unfavorable; the floe was covered with 3 feet of water-soaked snow. "We found we could tramp the snow under foot. Until June 13 we trod ceaselessly up and down the swathe." Fortunately the temperature dropped, and on June 15 at 10.40 A. M. the N25 took the air. The course was laid farther eastward. A good deal of fog was encountered, but in 8½ hours North Cape was reached, the landfall being the northern extremity of North-East Land.

The chief scientific result of the expedition is the bearing on the question of land in these regions. On the northward flight 100,000 square kilometers of unexplored area were observed, on the return 60,000 without such indication. At the point of descent, 160 miles from the pole, two soundings by Behmlot apparatus showed a depth of 3750 meters (2050 fathoms), which is in accord with Peary's observation 5 miles from the pole (1500 fathoms without touching bottom). This goes to confirm Nansen's idea of a deep polar basin.

Animal life seen by the expedition was limited to a glimpse of a single seal in a lead in the ice and three birds, two geese, and an auk flying northwestward. The latter, says Amundsen, suggests that land lies in that direction.

While on the ice observations were made on the drift and on magnetic variation and the meteorological situation. Among other problems on which the expedition sheds light is that of aerial navigation, a matter briefly discussed in the following note.

Aerial Navigation Near the Pole. The three recent expeditions to the Arctic, namely, the Amundsen-Ellsworth Expedition, the Oxford University Arctic Expedition, and the MacMillan Arctic Expedition under the auspices of the National Geographic Society, have shown the question of aerial navigation to be one of peculiar interest. The problem is beset by theoretical and mechanical difficulties. It may be divided into two parts: first the problem of steering a course, and second, the problem of finding geographical position.

Steering by magnetic compass near the poles is for various reasons very impracticable, chiefly because of the lack of knowledge of the magnetic declination, and also because the horizontal component of the earth's magnetism is weak. Captain F. Tymms, a member of the Oxford expedition, in one of a series of articles on this expedition appearing in the July and August numbers of the Royal Geographical Society's journal, is of the opinion, however, that the magnetic compass is not entirely useless but at the same time suggests that the ideal equipment on future occasions would be a sun compass with a magnetic compass in reserve. It was in this way that the problem of steering a direct course was more or less overcome by Amundsen, who used a solar compass made specially by Goerz, which he found to operate "with entire satisfaction." This instrument, provided the flight is maintained on a given meridian, indicates to the navigator true north, for once the instrument is set a clockwork mechanism automatically corrects for the constant change in the sun's hour angle. Information as to how corrections for the rapid change in the latitude of the airplane were made is not yet available, and hence it is assumed that this was done personally by the pilot as the flight proceeded. The corrections due to the change in the sun's declination were doubtless neglected, as these would be considerably smaller than the probable errors in the navigation itself.

The MacMillan expedition also proposed using a solar compass but of a different type and designed by Mr. Bumstead of the National Geographic Society. This was satisfactorily tested before the expedition left Wiscasset in Maine, but otherwise no information is forthcoming as to its efficiency.

It appears likely that determination of position while flying near the poles will never be made with the accuracy obtainable by explorers on the ground. The reason for this is obvious when one considers first of all the extreme difficulty of observing accurate altitudes of a celestial body from a rapidly moving airplane with a sextant, the only instrument at all practical for the purpose, and secondly the fact that as a rule the sun will be the only available body to observe on and that therefore only one position line can be determined at a time, all of which makes it necessary for the navigator to depend to a large extent on his dead reckoning. However, the problem of determining the distance and direction flown is being rapidly overcome with such instruments as speed and drift indicators, course and distance indicators, and smoke bombs. These instruments are described, together with the whole problem of aerial navigation and position-finding near the poles, in two excellent articles by Lieutenant Commander Byrd (in charge of the aerial operations on the MacMillan expedition) and G. W. Littlehales in the August number of the *U. S. Naval Institute Proceedings* (Vol. 51, No. 270).

From the foregoing remarks it is apparent that one solution of the difficulty of position finding near the poles would be for the airplane to make a landing when necessary and for observations to be made on the ground. But this is an extremely hazardous undertaking in the polar regions, as witness the experiences of the Amundsen-Ellsworth expedition. It is principally for this reason that experienced authorities are tending towards the opinion that the dirigible airship is the practical vehicle for polar flights.

It is of interest to record that Mr. Ellsworth, previous to departing from New York in April, availed himself of the facilities provided at this Society's School of Surveying for studying and discussing this difficult question of aerial navigation near the poles.

Argentine Interest in Antarctic Exploration. Guillermo Hoxmark in the article "La Argentina y las exploraciones antárticas" (*Anal. Soc. Científica Argentina*, Vol. 97, 1924, pp. 119–155) advocates Argentine participation in Antarctic exploration and puts forward practical suggestions for the organization and conduct of an expedition under the auspices of the republic. He commences with a historical survey from the voyage of Pedro Fernández de Quirós, who sailed from Callao in 1605 and discovered the South Shetlands, to Shackleton's last expedition. Next Mr. Hoxmark outlines the explorations yet to be undertaken in order to make clear the geography of Antarctica. Graham Land needs to be explored to the south of latitude 68° S. to determine whether it is an island or a part of the Antarctic continent. The coast from Charcot Land to Edward VII Land is unknown. There are large breaks between Cape Adare and Weddell Sea in which the character of the coast is unknown. The region of about longitude 70° W. is the region which offers the greatest probability of notable discoveries. If the unknown land is a continent then the mountains rising to 5000 meters encountered by Amundsen and Scott are the "Cordilleras Antarcticas" corresponding with those of South America, and it is to be expected that between Graham Land and Ross Sea there lies a chain of islands like those along the coast of Chile. The land on the other side may slope more gently toward the Atlantic, like the Pampas of Argentina. The projection of Graham Land toward Tierra del Fuego and the existence of volcanoes more or less of the same age as those of the southern Andes strongly suggest that these southern mountains are an extension of the Andean chain. Moreover, the remains of animals and plants of the Cretaceous epoch when

the climate was mild likewise suggest a former connection of South America with the Antarctic land surfaces.

Mr. Hoxmark then passes to the question of the best years for exploration and draws a curve derived from Mossman's collection of the observations of the duration of ice at Laurie Island. His curve appears to show that the duration of ice lags behind the inverted sun-spot curve about two years. The minimum amount of ice occurs about two years after sun-spot maximum, and the maximum amount of ice about two years after sun-spot minimum; so that if Shackleton, for example, had gone south in 1919 instead of 1915 he would have had a much better chance of success. This conclusion agrees with my own investigations, which show an excess of pressure in the latitude of South Georgia during years of sun-spot maximum, an increased air circulation in high latitudes, and an increased amount of floating ice, indicating that there must be a breaking up of the ice farther south.

Hoxmark, referring to Amundsen's introduction of the airplane into polar work, anticipates the use of the airplane in future Antarctic exploration and points out that it will be easier to land over the snow fields of the Antarctic continent than over the broken ice of the north polar basin. In conjunction meteorological factors, including wind and cloudiness, are discussed.

It may be remarked that one of the special disabilities in Antarctic, as compared with Arctic, exploration has been the difficulty of utilizing the pack for travel, as Wright and Priestley point out in their volume on Glaciology. Use of the airplane in the South Polar regions may soon be put to the test. It is reported that Captain George H. Wilkins, who was a member of the Canadian Arctic Expedition under Stefansson, will be leader of an aerial expedition to Graham Land in 1926.

Hoxmark also points out the need for specially built ships with V-shaped bottoms, on the lines of the *Fram* and the *Maud*, which are better able to withstand the crushing strain of adjacent ice floes than are ships with the usual U-shaped bottoms.

Finally he urges the importance of meteorological and magnetic observations in the far south and points out the opportunity for the Argentine government to take a leading part in such explorations.

H. H. CLAYTON

The Expedition of the Royal Research Ship "Discovery." Since its inception on an extensive scale in 1909 the whaling industry of the Falkland Islands Dependencies has advanced rapidly. Figures for the season 1922–1923 show an output of oil double that of the pre-war average in quantity, quadruple in value. It is noteworthy that this gain has been made chiefly as the result of more economic methods of utilization in consequence of the stringent regulations introduced in 1921 by the Falkland Island Government which has controlled the industry from the start. Conservation measures, however, could be still more effectively employed if the habits and migrations of the whales and the reasons for their fluctuating numbers were better understood. With this objective there was organized the *Discovery* expedition (*Nature*, No. 2903, Vol. 115, 1925, June 20, pp. 950–951).

The expedition is subject to the instruction of the Secretary of State for the Colonies. The cost is met entirely from public revenues raised in the Dependencies of the Falkland Islands. Dr. Stanley Kemp is Director of Research. The vessel, the Royal Research Ship *Discovery*, built for Captain Scott in 1901, has been refitted and completely equipped for the work. The expedition sailed from England in July and will be occupied for two years. It was planned to begin work in the Gulf of Guinea, thought to be the northern limit of migration of southern whales. After touching at Cape Town the course will be laid for South Georgia, where a laboratory has been established at Cumberland Bay. Thence the expedition will proceed to the South Shetlands.

As said above, the prime object is to secure information on whales, especially those species forming the basis of the industry now flourishing in the waters of South Georgia and the South Shetlands. Geographical exploration is not included in the program; but efforts will be made to improve our knowledge of the coast lines visited, and surveys will be made of the harbors frequented by the whalers. Furthermore, the ship is carrying two sets of echo-sounding apparatus, for shallow and deep water respectively, which it is hoped will afford valuable data.

PHYSICAL GEOGRAPHY

The Relation of Current to Wind. The wind has always been regarded as one of the principal causes of ocean currents, and it had been taken for granted that a wind blowing steadily over a wide stretch of water gives rise to a current which sets with the wind. This opinion received support from the mathematical investigation of the question published by Zöppritz ("Hydrodynamische Probleme in Beziehung zur Theorie der Meeresströmungen," *Annal. der Physik und Chemie*, Vol. 3 (N. S.), 1878, pp. 582–607). From this investigation it was concluded that a steadily blowing wind will, through friction, bring about a surface current in the direction of the wind; this surface layer will in turn put in motion, in the same direction, a lower layer of water until finally the whole mass of water from top to bottom will be flowing in the direction of the wind. These conclusions were accepted for many years, and it was only at the beginning of the present century that attention was directed anew to the matter. In studying the observations made on the drift of the ice during his North Polar expedition, Nansen was struck by the fact that for any given period the drift of the ice was almost invariably to the right of the corresponding wind resultant.

Nansen suspected that this deviation of the ice drift to the right of the wind was due to the deflecting force of the earth's rotation, and he therefore requested V. W. Ekman, the Swedish mathematician, to investigate the matter mathematically. In Zöppritz's work the effect of the earth's rotation was not considered, the assumption undoubtedly being that, since the velocities of wind-driven currents were never great, the effect of the earth's rotation would be so small that it might be completely disregarded. Ekman, however, introduced this deflecting force into his equations and on the assumption of a large body of water of infinite depth arrived at a number of unexpected results, one of which was that the current brought about by the wind, on the surface, sets 45° to the right of the wind in the northern hemisphere and 45° to the left in the southern hemisphere ("On the Influence of the Earth's Rotation on Ocean Currents," *Arkiv för Matematik, Astronomi, och Fysik*, Vol. 2, No. 11, 1905). Near the coast the direction of the wind-driven current is obviously very greatly modified by the coast. But it is only near the coasts of the northern hemisphere that systematic current observations have been made, and these show in general a deflection to the right of the wind. For example, current observations made by the Coast and Geodetic Survey on the lightships stationed along the Atlantic and Pacific coasts of the United States show that on the former coast the deviation is about 20° to the right of the wind, while on the latter coast it is about 15° to the right.

In an article on "The Relationship Between Current and Wind" (*Quart. Journ. Royal Meteorol. Soc.*, Vol. 50, 1924, pp. 113–119) C. S. Durst attempts a verification of Ekman's theory in the open sea. No systematic current observations are at hand for the open ocean, but Durst makes use of the navigator's determination of the position of his ship as he charts the course of his vessel across the trackless sea. Each day at noon the position of the ship is determined by means of astronomical observations. The distance steamed by the ship between these noon observations

is also determined by means of a patent log or by means of the number of revolutions of the propeller. This, together with the course steered, enables the navigator to calculate the "dead reckoning" position of his ship, or the position the ship would be in if unaffected by currents. For each day, therefore, the difference between the dead reckoning position and that determined by the astronomical observations gives the direction and velocity of the current for the preceding twenty-four hours.

Durst analyzed the relation of current to wind in various tracts of the ocean, and the result that stands out immediately is the deviation of the current to the right of the wind in the northern hemisphere and to the left of the wind in the southern hemisphere. This deviation varies somewhat, as is to be expected from the character of the observations, but in general it may be said to approximate 40°. The velocity of the wind-driven current Durst found to be directly proportional to the velocity of the wind and inversely proportional to the square root of the sine of the latitude.

H. A. MARMER

HUMAN GEOGRAPHY

Geographical Research and the Tropics. Fear that the time is approaching when the agricultural lands of the temperate zones will no longer suffice to support the white populations of the world is increasingly turning attention equatorward. Some even claim to see in the unoccupied spaces between the tropics an outlet for surplus white peoples. Indeed, one of the primary geographical questions of the future is whether or not white races can establish prosperous and populous settlements at low altitudes under the tropical sun, but it is a question of such complexity that we venture to believe only time and long experience, even suffering, will definitively answer it.

Professor J. W. Gregory in his address last year as president of Section E (Geography) of the British Association for the Advancement of Science at the Toronto meeting asserted that "the conclusion that the white man is not physiologically disqualified from manual labour in the tropics and may colonize any part of Australia simplifies inter-racial problems, as it provides an additional outlet and spacious home for the European race." This seems optimistic beyond the safety point. Along with certain other problems discussed by Professor Gregory (among them the American negro question) this one is surely neither as simply nor as easily solved as he argues and implies (J. W. Gregory: Inter-Racial Problems and White Colonization in the Tropics, *Rept. British Assn. for the Advancement of Science No. 92* (Toronto, 1924), London, 1925, pp. 125–147; also printed in *Pan American Geologist*, Vol. 42, 1924, pp. 81–111, and in *Scottish Geogr. Mag.*, Vol. 40, 1924, pp. 257–282).

Before we can come to conclusions in these matters there is much need for what Mr. W. R. Dunlop, in a paper delivered before the Royal Society of Arts, calls "research in economic geography and industrial and administrative efficiency with relation to the development of the tropics." Dunlop does not try to generalize about matters concerning which, after all, we have relatively few data to guide us. He rather suggests and illustrates possible methods of approaching these subjects and of acquiring the data necessary to deal with them. "The main issue," he says, "is the point of view, the philosophy, and the nature of the kind of research I am advocating." He holds "that a systematic study of the British tropics along the lines suggested, . . . would not only assist in economic development, but would intellectually increase our [i. e. British] world prestige, cost very little, and lead in the end to a much better understanding and closer sympathy . . ."

Mr. Dunlop sharpens the focus of his discussion of broader principles by the comparison of two tropical British colonies which superficially resemble each other in many respects but are at opposite poles as far as population and economic development are concerned. These are British Guiana and British Malaya. Both are approximately the same size; "both lie within a similar range of latitude . . . and what is of greater importance, they lie . . . in the two great tropical regions of maximum rainfall of over 80 inches per annum." Vegetation, diseases, soil, water power, a mountainous interior—these are common to both. But whereas British Malaya has a population of some 3,000,000, British Guiana has only 300,000. Whereas agriculture, forestry, and mining are actively pursued throughout the greater part of the former, most of the latter is a wilderness and much of it is unexplored.

Why should these differences prevail? What may be done to improve conditions in both colonies and especially in the more backward one?

The answer to the first question is to be sought mainly in geography and on the whole is not difficult, although the same question applied to the comparison of other regions might not always be so readily answered. The low coasts and shallow river mouths of British Guiana cannot be approached by large ships, and the rivers leading into the interior are difficult of navigation even for small craft. British Malaya, on the other hand, occupies a peninsula and has several fine harbors which render easy actual or potential access to all parts of the country. Furthermore, the mineral resources of British Guiana have "not been so lasting and extensive" as those of British Malaya; and, finally, while British Malaya lies on one of the main trade routes of the world, British Guiana is isolated from the channels of the world's affairs.

The second question involves essentially "investigations designed to enable us to make suggestions for improvement" in the relative efficiency of industries (including, of course, agriculture), "without any considerable increase in capital expenditure." These investigations must take into consideration such matters in the economic field as relative costs of production and of living, relative efficiency of labor ("tropical laziness," for instance); and in the administrative field, matters of land administration, forestry, public health, and scientific research. Efficiency in tropical administration, Dunlop believes, will come mainly from economic studies, inasmuch as it is mainly an economic problem. Throughout these economic studies, however, he insists that the geographical factor be kept to the fore. "The fundamental idea," he says, "is regional" (W. R. Dunlop: Economic Research in Tropical Development With Special Reference to British Guiana and British Malaya, *Journ. Royal Soc. of Arts*, Vol. 73, 1925, pp. 311–334).

The solution of the problems of the utilization of the tropics for the best interests both of white and colored races alike can come only through the pursuit of prolonged research similar to that which Dunlop suggests. As yet we are only on the fringe of such investigation.

HISTORICAL GEOGRAPHY

Travel in the Middle Ages. The recent publication in two small volumes of passages from medieval writings gives us a view of the character of medieval travelers and the conditions under which their wanderings were made. E. L. Guilford in his "Travellers and Travelling in the Middle Ages" (*Texts for Students*, No. 38, The Sheldon Press, London, 1924) aims to supplement the material so charmingly presented by Former Ambassador Jusserand in "English Wayfaring Life in the Middle Ages (XIVth Century)." Texts are quoted without comment covering a wide range of topics: crusades, pilgrimages, the traveling merchant, types of wayfarers (students, pirates, tinkers, gypsies, vagabonds), inns, dangers of the

road, outlaws and sanctuary, and witchcraft. The modern tourist will be entertained by a list of recommendations which William Wey prepared in the fifteenth century for intending pilgrims to the Holy Land. These suggestions are above all practical, reminding one of the introductory chapters of Baedeker. On arriving at Venice the pilgrim is advised: "Fyrste yf ye goo in a galley make yowre covenante with the patrone by tyme, and chese yow a place in the seyd galey in the overest stage, for in the lawyst under hyt ys right smolderyng hote and stynkynge. . . . Also that yowre patrone weff yow every day hote mete twyes at two meyls. . . . Also by yow a cage for half a dosen of hennys or chekyn to have wyth yow in the galey. For ye schal have nede un to them meny tymes."

The things that before all else interested the typical medieval pilgrim are illustrated in E. M. Blackie's "The Pilgrimage of Robert Langton Transcribed With an Introduction and Notes" (Harvard University Press, Cambridge, Mass., 1924). Until a copy was recently found in the Library of Lincoln Cathedral, it was believed that none existed of the original of Langton's little book. The black-letter reprint in Archdeacon Blackie's edition, resembling (but not a facsimile of) the original, from the typographical point of view does credit to the Harvard University Press and preserves the early sixteenth-century atmosphere. Langton was a British ecclesiastic of the old order who made the pilgrimage to the shrine of St. James of Compostella and incidentally journeyed widely through Spain, France, and Italy. His account is bald and dry. He mentions little besides the religious relics preserved at the various places he visited. About all that he writes of Compostella, for instance, is: "There is saynt James buryed. Also there is the heed of saynt James the lesse. Also pieces of the holy crosse. . . . Also bones of saynt Gregory. . . . Also a tothe of saynt Syluester with many other relykes." His obliviousness to anything else of interest forced Archdeacon Blackie to the conclusion, perhaps a little harsh, that Langton "was a man of dull mind." But before accepting this judgment it is well to remember that Langton's purpose was undoubtedly to provide a practical guide for those who were seeking relics. At all events his book gives us an admirable idea of the sort of thing that attracted the pious throughout the Middle Ages and that even now in many parts of the world is not without its allurement. An attitude of healthy scepticism toward the value of relics, however, was growing in Langton's time and is shown in some amusing passages from Erasmus quoted by Archdeacon Blackie in his introduction.

For references to other recent publications dealing with the history of travel at different epochs, see the *Geographical Review*, Vol. 11, 1921, pp. 628–629, and Vol. 13, 1923, pp. 149–150 and 655.

Cartographic Tendencies in the Seventeenth and Eighteenth Centuries. Two tendencies are apparent in the cartography of the seventeenth and eighteenth centuries. One led to the production of magnificent maps and atlases for sale to map lovers—or, at least to those who could afford them. The Dutch atlases of the Blaeus in the seventeenth century were truly works of art, sumptuous beyond any atlases published at the present time. From the point of view of accuracy, however, the makers of commercial maps of this sort were hampered by the lack of astronomically and trigonometrically determined points upon which to hang the topography and also by a prevalent prejudice against the publication of topographical details which might be of value to an enemy. The second tendency, on the other hand, led to the carrying through of accurate surveys for scientific, administrative, and, above all, for military purposes. The maps based on these surveys, rather than the work of the atlas makers, were the predecessors of the great national topographic maps of the nineteenth and twentieth centuries.

Johann Baptista Homann was a famous commercial map maker. In 1702 he established a cartographical workshop and publishing house in Nuremberg, an

enterprise which proved highly lucrative both to himself and his heirs. The two-hundredth anniversary of his death (1724) is commemorated in a recent brief biography by Wilhelm Eberle (Der Nürnberger Kartograph Johann Baptista Homann: Zu seinem 200. Todestage: Ein Lebensbild, *Mitt. und Jahresberichte der Geogr. Gesell. in Nürnberg*, Vol. 3, 1923–24, Nuremberg, 1924). Prior to Homann's day, French and Dutch maps had dominated the German markets, but Homann was soon able to replace these foreign maps by "equally good but cheaper German products." His maps were all of uniform size, in order that they might readily be combined in atlases. Unlike the Dutch cartographers, Homann consistently placed north at the top of the sheet, though his maps were uniform neither in scale nor projection. In representing relief he abandoned the earlier caterpillar style of showing hills, substituting a rude form of hachuring which gives the appearance of a bird's-eye view of the landscape. In some of the later maps the relief was shaded as if illumined by oblique rays of light. Eberle observes that "many sheets, particularly some of those dating from the last decade of Homann's life, reveal an astonishingly correct representation of the form of the countryside."

In point of time Homann's maps fall about midway between two surveys which illustrate the second cartographic tendency—the evolution of administrative and military mapping.

The first of these surveys was the work of the prior of the Augustinian convent at Fürstenfeld, Styria, between 1601 and 1605. The southern frontiers of the Austrian domains at this time were under a constant menace of Turkish attack, and hence the need of accurate maps was felt more keenly here, perhaps, than in other parts of Europe. In 1603 the Archduke Ferdinand of Austria commissioned Prior Johannes Clobucciarich to carry out a survey of Inner Austria (Styria, Carinthia, Carniola, Gorizia, and Northern Istria), but Clobucciarich's death intervened before the work could be brought to completion. The topographer's documents, however, consisting of letters, notes, field sketches, panoramas, and sketch maps, have been preserved and recently made the subject of a study by Fritz Popelka (Die Landesaufnahme Inner-Österreichs von Johannes Clobucciarich, 1601–1695, Graz, 1924; see also *Mitt. Geogr. Gesell. in Wien*, Vol. 66, 1923, pp. 101–106). This monograph is accompanied by twenty-nine plates, photographic reproductions of the more interesting of Clobucciarich's sketches, particularly of those representing the many strongholds which dominated the borderlands of Inner Austria.

Clobucciarich's incompleted work has somewhat more than mere local interest. It illustrates the necessarily crude topographical methods of what has been called the pre-geodetic period in the history of cartography (see *Geogr. Rev.*, Vol. 14, 1924, pp. 146–147). As careful as was possible under the circumstances, his survey was based not upon instrumental observations—though Clobucciarich made use of a compass for orientation—but upon the piecing together of data derived from sketches, panoramas, and sketch maps made during extensive wanderings through the country and the correlating of these by means of distances between important centers roughly measured along roads. What was lacking in topographical accuracy was made up for by the detailed rendering of the appearance of towns, villages, and castles.

Clobucciarich's methods were antiquated by the latter half of the eighteenth century. The advance in mapping is illustrated in a survey of the Electorate of Hanover begun in 1764 by the military engineers of that state with a view to finding the best route for a canal between the Elbe and the Weser, and extended to cover the entire Electorate under a decree of the Elector, King George III of England. The results of the survey were embodied in a manuscript map in 165 sheets on a scale of 1: 21,333⅓ (approximately three inches to one mile). Owing in part to the high cost of copper engraving and in part to the prevalent prejudice against the publication of topographical details, the map was not reproduced at the time. Re-

cently, however, the Historical Commission for Lower Saxony has undertaken to produce a reduced photographic facsimile on a scale of 1:40,000. Twenty of the 165 sheets have appeared, accompanied by a brief explanatory text by Professor Hermann Wagner of the University of Göttingen. Further sheets will be published as subscriptions for the work can be raised (Topographische Landesaufnahme des Kurfürstentums Hannover von 1764–86 (in 1:21333⅓): Lichtdruckwiedergabe im Massstab 1:40000, Part I, Historical Commission for Lower Saxony, Hanover, 1924).

Wagner points out that this map "is one of the most valuable cartographical monuments of the period when surveys of large areas were still rarities." The scale is much larger than that of either of two famous contemporary maps, the Schmettau map of the Prussian territories east of the Weser (1767–1780: 1:50,000) and the Cassini map of France (1750–1790: 1:86,400). Elevations are represented by hachure lines and the heavy shading of the steeper slopes. Streams are shown in blue. A variety of symbols is employed to distinguish between different types of terrain: deciduous and coniferous woods, meadows, plowland, moors, pastures. Roads and buildings are colored in various tints of red. The scale is large enough to bring out the street plans of the towns. Several different types of road are differentiated in the open country; and windmills, ruined castles, watchtowers, and other buildings are indicated by appropriate conventional signs. The Commission bringing out the reproduction is performing a signal service not only to students of Hanoverian history in the eighteenth century but to all who are interested in the broader aspects of the history of cartography.

GEOGRAPHICAL NEWS

Award of the Explorers Club Medal to Lieutenant Lowell H. Smith. The Explorers Club of New York has awarded its medal to Lieutenant Lowell H. Smith, leader of the U. S. Army Round-the-World Flight. This first aerial circumnavigation of the globe, it may be recalled, was completed at Seattle, Wash., on September 28, 1924, in six months all but a week, a distance of 27,544 miles being covered in 351 hours of flying time. (An official account of the flight appeared in the November, 1924, number of *Current History*.)

The Explorers Club Medal has been bestowed only a limited number of times, earlier recipients including Peary, Farabee, Rondon, and Stefansson. The presentation to Lieutenant Smith was made at Los Angeles on July 9, by Dean Bruce of the Southern Branch of the University of California. The sentiment of the award was voiced by Dean Bruce: "When we consider the untiring energy, the inexhaustible resourcefulness, the unbroken courage with which you and your colleagues brought your airplanes through a half year of blizzards, fogs, typhoons, monsoons, sand storms, from our continent back to our continent; when we consider the significance to us all of your circumnavigation of the globe, by airship, four hundred years after Magellan's circumnavigation of it by sailing ship, then we may feel ourselves greatly privileged to be able to present to you today this medal of the Explorers Club, honoring the Pathfinder of the Air."

Honor to Dr. Edwin R. Heath. Dr. Heath, whose services to Bolivian exploration are commemorated in the branch of the Beni that bears his name, has received a further honor at the hands of the Bolivian government. This is election to the Order of the Condor, a new order of merit created by Bolivia as a centennial memorial. Dr. Heath was elected a Corresponding Member of the American Geographical Society in 1924 (see *Geogr. Rev.*, Vol. 14, 1924, p. 467).

Obituary

William Curtis Farabee. William Curtis Farabee, Curator of the American Section of the University Museum, Philadelphia, died at Washington, Pa., on June 24, from pernicious anemia consequent on hardships sustained in his several South American journeys. Dr. Farabee's notable series of explorations in this field commenced with his leadership of the De Milhau-Harvard expedition (1906–1908), the results of which were published as "Indian Tribes of Eastern Peru" (*Papers of the Peabody Museum of American Archeology and Ethnology, Harvard University*, Vol. 10, 1922).

The second expedition, 1913–1916, was made under the auspices of the University Museum, Philadelphia. The expedition visited four widely separated areas mainly in the Amazon basin: the Guiana highlands, the Ucayali River in Peru, the island of Marajó at the mouth of the Amazon, and a section between the Tapajóz and Xingú Rivers. The narrative of the expedition published in the *Museum Journal* and elsewhere (see *Geogr. Rev.*, Vol. 3, 1917, p. 149, and Vol. 4, 1917, pp. 397–398) contains many interesting geographical observations, as for instance the too brief reference to the country penetrated between the Tapajóz and the Xingú, where Dr. Farabee approached from the north the unknown region that Colonel Fawcett proposes to enter from the south. Fine collections of archeological and ethnological material were secured. Results of this expedition are Volumes 9 and 10 in the Anthropological Publications of the University Museum, Philadelphia, "The Central Arawaks" (1918) and "The Central Caribs" (1924) respectively.

Another expedition to Peru was undertaken in 1921–1923 and important material obtained, which however has not been worked up. Dr. Farabee also acted as one of the ethnographers to the American Commission to Negotiate Peace, Paris, 1918–1919.

GEOGRAPHICAL REVIEWS

The British Empire's Resources

The Resources of the Empire: A Business Man's Survey of the Empire's Resources Prepared by the Federation of British Industries. Each volume containing a foreword by H. R. H. the Prince of Wales and a general introduction by Sir Eric Geddes. Indexes. 10 vols. in 12. Vol. 1, Food Supplies, by J. R. Ainsworth-Davis: Part I, Crops and Fruits; Part II, Meat, Fish, and Dairy Produce; Vol. 2, Timber and Timber Products, Including Paper Making Materials, edited by S. J. Duly; Vol. 3, Textile Fibres and Yarns, by J. S. M. Ward; Vol. 4, Fuel, edited by G. W. Andrew; Vol. 5, Rubber, Tea, and Cacao, With Special Sections on Coffee, Spices, and Tobacco, compiled and edited by W. A. Maclaren; Vol. 6, Leather, Hides, Skins, and Tanning Materials, by E. C. Snow; Vol. 7, Chemicals, by A. W. Ashe and H. G. T. Boorman; Vol. 8, Part I, Ferrous Metals, by M. S. Birkett; Part II, Non-Ferrous Metals and Other Minerals, by N. M. Penzer; Vol. 9, Oils, Fats, Waxes, and Resins, by E. R. Bolton and R. G. Pelly; Vol. 10, Communications, by W. T. Stephenson. Ernest Benn, Ltd., London, 1924. £7, 7s. 10 x 7½ inches.

On the occasion of the British Empire Exhibition at Wembley the Federation of British Industries published a series of volumes which constitute a valuable source of data on the economic situation of the British Empire and on the possibilities of further development of its commerce and industry.

Since the war the economic situation of the Empire has been greatly changed. Trade with the Orient and South America has fallen off, as is the case with several other countries where English importations encounter an ever rising tariff barrier. On the other hand, the Empire has seen its production capacity and number of workers increase. A reorganization of commercial policy was in order which should seek to integrate metropolis and dominions into a unit capable of furnishing all the necessary materials for its own subsistence and also of absorbing as much as possible of the goods manufactured.

The statistics for 1923 show that importations into the metropolis from the various parts of the Empire have increased since the war while exportations from the metropolis to the dominions have remained at about the same value.

Table I—Percentages of Imports and Exports

Country	Imports to Great Britain		Exports from Great Britain	
	1913	1923	1913	1923
British India	6.3	6.0	13.4	12.2
Self-Governing Dominions	13.3	16.3	17.5	18.0
Other British Countries (except Hongkong)	5.3	5.3	5.4	5.7
Europe	40.4	33.2	34.4	34.2
United States	18.4	19.6	5.6	8.0
South and Central America	10.0	10.8	10.6	8.8
Other Countries	6.3	8.8	13.1	13.1

Now, the consumption per head of British products is very unevenly distributed: feeble in the thickly populated territories of India and British Malaysia, £0.2 and £0.5, it rises to £12.3 in New Zealand, £7.8 in Australia and is £2.3 in Canada and £2.1 in South Africa. This inequality has nothing surprising in it, and the authors of the several works in the series do not fail to point out the field for expansion thus offered in the different parts of an empire that in 1921 furnished 8.5 per cent of the world's production of copper, 22.9 of the lead, 42.2 of the tin ore, and 77.1 of the wool.

The metropolis has attained an economic development permitting it to play a highly efficient rôle in this vast British association; but it is necessary that the buying power of the Dominions should be increased as their productive power grows, and for promotion of the latter the metropolis must develop its consumption of Dominion products.

As regards purchasing power the dominions of the tropical zone must be distinguished from those of subtropical and temperate zones. For the former, in which the white population is limited in numbers and power of work, one must especially depend on capital and British materials while fostering native needs. For the latter the first effort must be rapid increase of the white population; this already increases, but it is useless to stimulate immigration unless opportunity for labor exists: call for labor and development of resources go hand in hand.

Great Britain has then a difficult problem to solve, and it is to aid in the solution that this series of volumes has been published. True, perfection cannot be claimed for this work; but inaccuracies revealed can be corrected and data completed in revised editions, which may perhaps follow.

In a brief review it would be impossible to give a survey of the 12 volumes, but the following notes on one of them selected at random will give some idea of the scope of the work.

The volume "Ferrous Metals" of 165 pages (including index) commences with a historical survey of the metallurgical industry, an excellent résumé of the question illuminated with very useful statistical tables. The author then passes in review the various sides of the problem, entering into the matter in detail, as is shown by the titles of some of the 17 chapters: The Raw Materials of the British Iron and Steel Industry; Pig Iron; Wrought Iron; the Sheffield Industries; Tinplates; Rails, Tyres, and Axles. The conclusion compares the metallurgical situations in the world market of the United States, British Empire, France, and Germany. The author, remarking on the increase in production in the United States and France, ends by declaring that Great Britain must inevitably continue to make steel as she did before the war, for she is the only country with suitable coal supplies on the coast to which foreign ore can be brought by sea and the product reshipped.

M. LEBRUN

LIFE AND THOUGHT IN INDIA

THE EARL OF RONALDSHAY. **India: A Bird's-Eye View.** xiii and 322 pp.; map, ills., index. Houghton Mifflin Co., Boston and New York, 1924. $5.00. 9 x 6 inches.

THE EARL OF RONALDSHAY. **Lands of the Thunderbolt: Sikhim, Chumbi & Bhutan.** xvii and 267 pp.; map, ills., index. Houghton Mifflin Co., Boston and New York, 1923. 9 x 6 inches.

Lord Ronaldshay, president of the Royal Geographical Society and former governor of Bengal, knows the East not only as an administrator but as a scholarly and sympathetic observer of life and thought. His volume on India, though a "bird's-eye view" which deals mainly with external matters, is much more than a

collection of superficial impressions. His bird's-eye vision penetrates beneath the surface close to the heart of many of India's material and spiritual problems.

Among the numerous topics touched upon are: architecture and architectural sculpture as embodying religion and mythology in stone; the ever-present menace on the northwest frontier; local self-government and village life; the introduction of the factory system into a land where the Industrial Revolution has not taken place. Some see in industrialization the solution of certain of India's difficulties, but Lord Ronaldshay asserts that "the organisation of industries on the lines evolved by the Western nations—industries, that is to say, which . . . necessitate the aggregation of vast numbers of human beings to perform for a fixed wage so much of [an] operation as cannot be performed by [a] machine—is something which is altogether alien to the genius of the Indian people." Lord Ronaldshay feels that India should not be regarded as a nation but as a continent with all the conflicting interests to which the juxtaposition of different nations and regions and traditions give rise. "The existence of the 70,000,000 Moslems in India is the most formidable obstacle in the way of those whose battle-cry is 'India a nation.'"

Perhaps more penetrating and original than any other part of the book are the chapters in which the author undertakes a task few Occidentals are capable of handling, the task of interpreting for Western readers the deeper and more obscure qualities of the Oriental mind. Here he tries to explain the tinge of pessimism, the strain of "submissive sadness" so characteristic of the Hindu. This is partly the result of physical languor induced by almost chronic disease, which is bred in turn by the hot, damp climate and malsanitation. In the villages of Bengal the germs of malaria are in the blood of nearly everyone. The physical cause of pessimism, however, is if anything less potent than the intellectual. From the dawn of history the Hindu has believed that he is bound to the wheel of life, destined irrevocably to suffering and sorrow not only through this wordly existence but through infinite cycles of transmigration. The search for a means of escape from this bondage has been the perpetual quest of the sages of Hindustan.

"Lands of the Thunderbolt" is partly a narrative of travel in Sikhim and Bhutan and partly an explanation of the historical background and essential character of the curiously perverted form of Buddhism that prevails in the eastern Himalayan valleys. Amazing tangles of superstition and demon worship, with a complex mythology and an absurdly mechanical conception of prayer, have grown like weeds about the beautifully logical and cleancut teachings of Gautama. Lord Ronaldshay, nevertheless, sees the influence of that great teacher still alive "among lamas and laymen alike" in "an attractive gentleness and kindliness of disposition, a dignified and courteous hospitality, and withal a cheerfulness and friendliness." The title of the book is taken from the thunderbolt, an emblem of the Buddhist priestly power.

A Geographical Dictionary of Chile

Luis Riso Patrón. **Diccionario Jeográfico de Chile.** xxiv and 958 pp.; bibliogr. Imprenta Universitaria, Santiago, 1924. 10½ x 8 inches.

The author of this volume is well known as a former director of the Oficina de Mensura de Tierras of Chile and chief of the Comisión de Límites, as well as for the great map of Chile on the scale of 1:500,000 compiled under his direction and for various articles on the cartography of Chile. The "Diccionario" is a valuable compendium of the geography of Chile. It comprises over 28,000 short descriptive notes, alphabetically arranged, on the cultural and topographic features of the country. The compilation includes population statistics and descriptive notes on the provinces and centers of population, statistics of mineral and agricultural pro-

duction, location and descriptions of topographical features, altitudes of important mountain peaks, the velocity and volume of rivers, and notes on geography, geology, and rainfall of the various geographical provinces of the country. The material has been assembled in a thoroughly workmanlike manner, and each entry in the dictionary is accompanied by references to the sources of information. The introduction to the dictionary contains an article on the general geography of the republic and a bibliography of nearly 200 entries. Especially valuable is the definition of a large number of geographical terms of purely Chilean usage and also many of Spanish and Indian origin. The volume offers in convenient form a great amount of statistical information which could otherwise be obtained only from unpublished statistics in governmental archives. The work should be of especial value to cartographers inasmuch as it contains much information not set down on any map of the country.

Geographical Data on Minas Geraes

Alvaro Astolpho de Silveira. **Memorias chorographicas.** Vol. 1, 353 and xvi pp.; maps, ills., index; Vol. 2, 355–703 and xxxiii pp.; ills., index. Bello Horizonte, [Brazil,] 1921–1922. 9 x 6 inches.

Scientific knowledge of Brazilian mountains is woefully meager. Massena, Homen de Mello, Glaziou, Liais, Derby, Branner, Hart, and others have labored much to advance the orography of Brazil; but the territory is vast, and much of the earlier work is exceedingly inaccurate. "With the exception of the work of the geographic commissions of Minas Geraes and São Paulo, which made systematic determinations of altitudes in the territory explored by them, we have had little in the way of altimetric exploration. And the number of those who have climbed the important high points in the national territory for the purpose of determining their altitudes will hardly reach a dozen." The condition of affairs that he thus describes Dr. Silveira has sought to remedy. As Chief Engineer of the Commissão Geographica e Geologica de Minas Geraes, he has had abundant opportunity to explore his home state, perhaps the most mountainous in the entire country, and the volumes before us embody many of the facts learned by him during the progress of his explorations.

Volume 1 opens with a discussion of the high points of Brazil. The two highest peaks in the Republic are the Pico da Bandeira and the Agulhas Negras (Pico do Itatiaya), about which more will be said presently. After them are listed fourteen points of more than 2000 meters altitude and nineteen that rise between 1500 and 2000 meters. As might be expected, the former are grouped in the big ranges of Caparaó, Mantiqueira, Espinhaço, and Orgãos. The points of the second category are more widely scattered, though only peaks that rise within the State of Minas Geraes or along its boundaries are considered. This may be explained by the fact that the volumes deal only with this single state; for, as an official of Minas Geraes, Dr. Silveira's explorations were naturally limited to that commonwealth. On the other hand, it may be pointed out that the two highest ranges in the whole of Brazil serve as the southern and eastern boundaries of Minas Geraes while the third in altitude rises in the center of the state.

While these volumes do not pretend to be exhaustive manuals of the regions covered by them, they do contain a vast amount of information of varied character and many new data. The range of subjects discussed includes altitudes, distances, mineralogy, diamond mining, copper mines, wells, climate, husbandry, cattle raising, fruit production, soils, forests, geology, rural medicine and charms, malaria, folklore, religious ceremonies, caves, old Indian inscriptions, and native flora. It may be mentioned that besides his attainments as an engineer and geologist,

Dr. Silveira is a botanist of considerable note in his own land and has himself described new species of plants discovered on his travels.

It is but natural that the two highest mountains of Brazil should excite the greatest popular interest as well as scientific attention. The reviewer was privileged to make an ornithological survey of the more famous of these and a reconnaissance of the higher, and incidentally he climbed both. The former, the Pico do Itatiaya, has for decades been accessible and has attracted workers in the various fields of geography, geology, botany, and zoölogy; and from the beginning speculation has been rife as to its altitude. In 1867 José Franklin da Silva Massena, who had still earlier called attention to the great height and majesty of this mountain, published in his "Quadros da naturesa tropical ou ascensão scientifica ao Itatiaia, ponto culminante do Brazil," the results of a combination barometric and trigonometric computation of the altitude of Itatiaya as 2994.5 meters.

Despite the obviously unsatisfactory methods employed by Massena and the fact that at least four subsequent measurements by as many different engineers have all fallen far short of his calculation (the average is 2821 meters), Massena's figures have been handed down to this day as the true elevation of the peak and appear as such even in the best Brazilian atlas. Thus for more than a century the Pico do Itatiaya has been proclaimed the culminating peak of Brazil. But a few years ago Dr. Silveira measured a peak marking the boundary of the most populous state in the Union and discovered its height to exceed that of Itatiaya by many meters! This is the Pico da Bandeira, the highest point of the Serra do Caparaó (2884 meters).

In Volume 2 are included two chapters on the Botocudo Indians and a third giving a short vocabulary of their language. In this connection it is interesting to note that there yet remains, even within the progressive State of Minas, a large tract of virgin forest, lying between the Rios Doce and Suassuhy Grande and the Serra dos Aymorés, which has yet to be penetrated by civilized man. It is here that the savages find sanctuary. The fact that this region is distant less than three hundred miles from Rio de Janeiro, national capital and a city of nearly a million inhabitants, illustrates what a land of contrasts Brazil really is.

ERNEST G. HOLT

TRAVELS SOUTH OF THE STRAIT OF MAGELLAN

A. M. DE AGOSTINI. **I miei viaggi nella Terra del Fuoco.** 296 pp.; maps, ills. Flli. De Agostini, Turin, [1923.] 125 lire. 11½ x 8½ inches.

ROCKWELL KENT. **Voyaging Southward From the Strait of Magellan.** xv and 184 pp.; maps, ills. G. P. Putnam's Sons, New York and London, 1924. 11 x 9 inches.

South of the Strait of Magellan lies a vast archipelago. Much of it is a wild region of mountains, glaciers, and tangled forests, interlaced by an intricate system of sounds and fiords and swept almost unceasingly by storms from the west. Many of the inlets have never been surveyed, and the mountainous interiors of some of the islands are wholly unknown. A few Alaculoof and Yahgan Indians of a low order of civilization make a scanty living by fishing among the sounds, and here and there a tiny settlement may be seen on the water's edge—a mission, perhaps, or a sawmill, or possibly a lair of fugitives from justice. Immense and almost impenetrable tracts are wholly without population, and west and northwest of Cape Horn the huge swells of the South Pacific beat for hundreds of miles on a treacherous, unlighted, and uninhabited coast. The mountains form the southernmost extension of the Andes and are continued east of Le Maire Strait in the almost fantastically precipitous peaks of Staten Island.

The northern and eastern parts of Tierra del Fuego are very different. Here a wide plain slopes gently to the Atlantic; north of the Rio Grande it is open, swept by furious icy winds in winter, cool in summer, grazed over by two million sheep. South of the Rio Grande the plain forms a park country with woods and meadows. These districts used to be the hunting grounds of the Onas Indians, a people whose magnificent physique, in contrast to that of the puny natives of the coastal zones farther west, gave rise to early travelers' tales of Fuegian giants. But a ruthless war of extermination has been waged against these Indians by land-greedy settlers from the north, and the race is now nearly extinct.

The spell which Tierra del Fuego with its neighboring islands lays upon those who visit it is reflected in the two books under review. Each is the work of a man of imagination and literary power. Father De Agostini was for many years a Salesian missionary at Punta Arenas, at heart an explorer, mountaineer, and man of science as well as a philanthropist. His wanderings in this remote archipelago between 1910 and 1918 took him from the pampas on the north to Cape Horn on the south and from Cockburn Sound in the west to Staten Island in the east. By reason of his wider knowledge of the country and its people, his book is the more informative and geographically the more valuable of the two; Kent's, avowedly the impressions of an artist in search of adventure, the more romantic. De Agostini's volume is lavishly illustrated with photographs, some of which—especially those in color—are of extraordinary beauty. Kent's woodcuts in bold black and white vividly convey a sense of the somber and almost sinister charm of the Fuegian landscape.

Both De Agostini and Kent broke new ground. A dramatic episode in the former's journey of 1913 was the discovery of two deep and hitherto unsuspected fiords penetrating from the head of Keats Sound far into the heart of the western peninsula of Tierra del Fuego and not shown on the charts of the British Admiralty or U. S. Hydrographic Office. One of these fiords was subsequently named after De Agostini by the Chileans. Accompanied by Alpine guides the padre also carried out several risky expeditions among the mountains and glaciers overlooking Admiralty and Beagle Sounds, notable among them being the first ascent of the astonishingly abrupt peak of Monte Olivia, northeast of the forlorn village of Ushuaya. His most important single exploit, however, was the crossing of the main cordillera of Tierra del Fuego from the western end of Lake Fagnano to Beagle Sound at a point a few miles west of Ushuaya. The route lay for several days through almost impassable forest thickets and dangerous bogs, across swollen streams, and over wild mountains. Kent made a similar traverse of the range by a pass somewhat to the west of De Agostini's route.

De Agostini's volume is accompanied by an excellently clear map (1:1,000,000) representing the whole of Tierra del Fuego and the Strait of Magellan. Two small maps (1:400,000) show the vicinity of the De Agostini Fiord and the region between Ushuaya and the head of Admiralty Sound. A full discussion of the glacialogical observations made in the course of De Agostini's expedition of 1913 by G. B. De Gasperi (Primi appunti sui ghiacciai della Terra del Fuoco)—who was subsequently killed in the World War—was postumously published by Giotto Dainelli in a volume of De Gasperi's papers, "Scritti vari de geografia e geologia," Florence, 1922, pp. 221–272.

The Falkland Islands

V. F. Boyson. **The Falkland Islands.** With Notes on the Natural History by Rupert Vallentin. xii and 414 pp.; maps, ills., bibliogr., index. Oxford University Press, American Branch, New York, 1924. $5.00. 9 x 6 inches.

The Falkland Islands have a considerable and interesting history to the narrating of which Miss Boyson devotes half of her book. Part II describes the growth

of the present dominant industries—sheep raising and whaling, with a chapter on the destructive sealing that led to the extinction of the economically valuable species. Part III, entitled "Geophysical Notes" deals with climate, the famous "stone rivers" and the theories regarding them, and the flora. Part IV, "Zoölogy," contributed by Rupert Vallentin, gives the results of his own observations carried on during several visits to the islands. Altogether a useful and informative volume.

Hydrographical Studies on New York Harbor

H. A. Marmer. **Tides and Currents in New York Harbor.** v and 174 pp.; maps, diagrs., index. *U. S. Coast and Geodetic Survey Special Publ. No. 111*, 1925.

Mr. H. A. Marmer gives the results from the detailed observational material for New York Harbor on file in the office of the Coast and Geodetic Survey, the material including a large amount of current data obtained from a recent comprehensive current survey conducted jointly by the U. S. Coast and Geodetic Survey and the U. S. Engineer Office of the First District, New York. The treatment is non-mathematical in character. Of special interest are the first two sections which serve as an introduction to the work. These sections contain an excellent discussion of the general characteristics of the tides and tidal currents, applicable to all parts of the world. This is followed by a discussion of the observational data for New York harbor, special attention being given to the relationship existing between the physical features of the waterways and the tidal movement. For the purposes of the publication the harbor is taken to include not only the Upper and Lower Bays but also East River, Harlem River, Hudson River as far north as Mount St. Vincent, Newark Bay, Kill Van Kull, and Arthur Kill. Each of these sections is treated separately, first for the tides and afterwards for the currents. For each of the waterways charts are given showing the location at which tidal and current observations have been made, and also tables showing the results of these observations. The tidal observations at Fort Hamilton, covering a period of thirty years, afforded a valuable record for the study of changes in the tides and tidal data from year to year. The concluding portion of the work gives a summary of the movement of the tides and currents throughout the harbor. This is illustrated by a set of diagrams, one for each hour of the tidal cycle, on which the direction of the current is shown by arrows and the condition of the tide by the letters "R" or "F," to signify whether the tide is rising or falling.

The work is a valuable addition to our literature on tides and currents, serving not only the purpose of the engineer but also providing the geographer and other scientists with a means for obtaining a better understanding of the tides and currents, especially for New York harbor.

Paul Schureman

Physiography of Nova Scotia

J. W. Goldthwait. **Physiography of Nova Scotia.** iv and 179 pp.; maps, diagrs., ills., index. *Geol. Survey of Canada Memoir 140: Geol. Ser. No. 122*, Ottawa, 1924.

It was a happy decision of the Geological Survey of Canada to make available for visitors and local residents a nontechnical yet authoritative account of the origin of Nova Scotian scenery. The task of preparing such an account has been accomplished by Professor Goldthwait in a manner that places both the layman and the scientist deeply in his debt.

Not since Daly's essay on "The Physiography of Acadia" has so useful a study of the physical features of Nova Scotia appeared; and Daly's classic paper dealt briefly with the larger features of a much more extended area. In a volume of a

little less than two hundred pages Goldthwait has given us our first fairly complete account of the physiography of Nova Scotia as a whole. The scheme of treatment is simple, as befits a work destined primarily for general use. A statement of the theory of land form evolution, covering less than three pages, introduces the reader to his subject. The upland peneplain, developed with remarkable perfection in parts of Nova Scotia and giving in northern Cape Breton Island some of the finest examples of nearly flat erosion surfaces on crystalline rocks the reviewer has ever seen described, forms the theme of the second chapter. Under this heading the faulted and warped trap ridge of North Mountain, the history of the drainage systems of the province, and the theories of origin of the upland peneplain are discussed at length. Goldthwait inclines to the opinion that the characteristics of the upland and its drainage favor a subaerial origin for the peneplain, as opposed to the marine origin suggested by Barrell for much of the New England upland.

The author next turns his attention to the lowlands etched out by erosion on broad belts of weak rock and frequently partially submerged by the sea. Then follows a chapter on features due to glaciation in which the author gives the results of his own extensive studies of ice action in the region described. Here the geologist and geographer will find important discussions and conclusions relating to possible centers of ice accumulation and the directions of ice movement in Acadia, descriptions of some of the most remarkable drumlin areas on the Atlantic coast, and very beautiful photographic illustrations of diverse glacial phenomena.

Two chapters on the sea border conclude the volume, one relating to the present forms of the shore, the other to past changes of level. The so-called fiords of Nova Scotia are shown to be submerged normal valleys but little modified by ice action; tidal currents are proved sufficiently strong in constricted passages to excavate or maintain scour holes of considerable depth; and the phenomenal changes in the size and form of Sable Island are illustrated. As for past changes of level, the author describes and explains the significance of elevated beaches and of submerged forests; but his extended analysis of the supposed indications of progressive subsidence in modern or historic time shows that these indications are deceptive, while other evidence is presented to prove complete coastal stability for the last century and a half.

The work is exceptionally well illustrated with effective diagrams, abundant photographs including two beautiful panoramas on folded inserts, and a large physiographic map on the scale of eight miles to the inch.

DOUGLAS JOHNSON

ANIMAL LIFE IN THE YOSEMITE NATIONAL PARK

JOSEPH GRINNELL AND T. I. STORER. **Animal Life in the Yosemite: An Account of the Mammals, Birds, Reptiles, and Amphibians in a Cross-Section of the Sierra Nevada.** xviii and 752 pp.; maps, diagrs., ills., bibliogr., index. (Contrib. Museum of Vertebrate Zoölogy, Univ. of California.) Univ. of California Press, Berkeley, 1924. $7.50. 10½ x 7 inches.

This is primarily an account of a zoölogical survey cross section of the Sierra Nevada, including the Yosemite National Park. It involves an area 89¼ miles in length by 17¾ in width and includes the eastern part of the San Joaquin valley on the west across the Sierras to Mono Lake on the east and thus includes the western part of the Great Basin.

The authors believe that temperature is the major controlling factor in the formation of life zones, but at the same time they point out that on the eastern slope of the Sierras, where aridity is so marked, the zonal arrangement is very confusing. Fires have, no doubt, also been an important factor influencing the boundaries of certain zones, a point to which the authors gave slight attention.

The great bulk of this attractive book consists of an extensive annotated list of the 362 kinds of animals considered. The density of the bird population was determined by careful census studies, totaling 250 of such estimates. The bear population in Yosemite valley is placed at from 15 to 20 and for the whole park at 125. The estimate for the cougars is placed at from 20 to 25 for the park, or about one to a township. The pocket gophers are calculated to excavate during one winter about 3.6 tons of soil per square mile, or for the whole park 4100 tons.

The authors point out the importance of many conservation measures, such as the need of keeping the park in as wild a state as possible; the necessity of dead and down timber for many kinds of animals; the danger to the deer of their being forced to winter on lands heavily grazed by domestic animals; and, it should be added, the menace of diseases derived from domestic animals.

The volume is beautifully illustrated by half-tones, excellent colored plates, and maps. It is the finest volume so far published on the animals of our National Parks.

CHARLES C. ADAMS

SCANDINAVIAN FAUNAL DISTRIBUTION

SVEN EKMAN. **Djurvärldens utbredningshistoria på skandinaviska halvön.** xvii and 614 pp.; maps, ills., bibliogr., index. Albert Bonniers, Stockholm, 1922. $15.00. 10 x 7 inches.

During the latest glaciation some tens of thousands of years ago all Scandinavia, with the exception of nunataks and islands on the Norwegian west coast, was buried beneath ice. In the ice-free areas an arctic flora and fauna survived the glaciation. The other plants and animals that were not killed by the changed climatic conditions were driven by the expanding ice to central and eastern Europe. Here they mingled with plants and animals that the advance of the glaciers had forced to descend from the Alps and other high mountains. When ice sheet and glaciers waned, mixed nordic and alpine floras and faunas took possession of the uncovered ground. As the age of the retreat in Scandinavia is exactly known, the later geological and geographical events and climatic evolution of Scandinavia are better known than those of any other region. Furthermore, as practically the whole flora and fauna has immigrated since the disappearance of the ice, the Scandinavian Peninsula is fairly unique from the zoögeographical point of view; and Ekman's book, bringing together all the material relating to the fauna, is of exceptional value.

The first part of the book (pp. 1–303) deals with the present distribution of the animals, which are divided into nine geographical groups. The vertebrates are treated separately, while the invertebrates are treated by groups except in the case of forms of unusual interest. This section contains a vast amount of information, in many cases made clear by excellent maps.

The second part (pp. 305–543) discusses the causes of the present distribution and the history of the fauna. It deals chiefly with the relation of the fauna to climate and vegetation, migrations, topographic obstacles to migrations, history of the fauna, sequence of immigration, postglacial history of Scandinavia, time as a zoögeographic factor, relation of the Scandinavian fauna to that in extra-Scandinavian regions, relicts from the interglacial fauna, routes of immigration, effect of the glacial period on the European fauna, endemism, etc.

During the 13,500 years that have elapsed since the ice edge left central Scania and began rapid retreat and the flora and fauna began to immigrate, no endemic species of higher animals have been developed. The Norwegian lemming (*Lemmus lemmus*) to be sure is endemic, but it goes far back in time, having survived the last glaciation on the Norwegian west coast and not in central or eastern Europe.

However, a few new species of crustaceans and insects have originated in postglacial time. Also because of the short time since the land became habitable many forms have not yet reached their natural limits of distribution.

The relict fauna comprises relicts from the arctic sea, that is from the sea bordering the retreating ice sheet, from the transgression of the postglacial sea, from the early postglacial fresh-water stage of the Baltic, from the postglacial stage of the Baltic when the salinity was about twice the present, and from the postglacial temperature maximum which prevailed from about 7000 to 3500 to 2500 years ago. The arctic relicts have undergone important morphological and ecological modifications.

The third part (pp. 545–580) deals with the geographical divisions of Scandinavia, their physical conditions and fauna.

The work is well illustrated, primarily with numerous good maps from which much information can be gained by persons unfamiliar with the Swedish language. The excellent standard of the work as a whole is well shown by the fact that, although written by a zoölogist, the geological and climatological sides are duly considered and their treatment is exact and up to date. It is a work of unusual interest and importance.

ERNST ANTEVS

SOUTHWESTERN GREENLAND: COUNTRY AND NORSE SETTLEMENTS

N. W. NISSEN. **Die südwestgrönländische Landschaft und das Siedlungsgebiet der Normannen.** 112 pp.; maps, diagrs., bibliogr. (Abhandl. aus dem Gebiet der Auslandskunde, Vol. 15.) University of Hamburg, 1924.

This scholarly volume deals with the physical geography of southwestern Greenland, its presumable influence upon the Norse settlements of the Middle Ages, and the probable fate of these settlements. The author has thoroughly combed the available literature on the subject, but unfortunately his monograph appeared too early for account to be taken of the published results of Poul Nörlund's striking discoveries at Herjolfsnes (discussed in this number of the *Geographical Review*, pp. 605–616). It is possible that these discoveries might have led him to modify some of his views.

The work opens with a brief exposition of the little that was known from documentary sources and archeological evidence acquired before Nörlund's excavations in regard to the history, culture, and economic life of these settlements. The settlements, which were primarily devoted to cattle raising, were scattered along the shores of deep fiords that penetrate a strip of land varying from thirty to sixty miles in width and separating the outermost fringe of reefs and islets from the inland ice. Under the influence of the sea, the isotherms in this narrow belt run in general parallel to the coast, though the climate of the interior is somewhat more extreme than it is nearer the ocean. In particular the seaward margin is chilled in summer by the ice-laden current that swings around Cape Farewell. Glaciers discharge into the heads of many of the fiords. It is on the shores of the relatively few ice-free fiords—those into which reefs prevent the entry of ice from the sea and which do not head in glaciers—that the most favorable spots for settlement were to be found, and it is here that the ruins of the Norse farms cluster in the greatest numbers.

The vegetation of the region resembles in some ways that of the higher mountains of the eastern United States. Birch thickets grow, with trees four to five and sometimes as much as six meters tall, in favored localities on the south-facing slopes where the sun shines more warmly and where there is less exposure to the föhn winds blowing down from the inland ice. Willow scrub seems hardier than birch

and is more widely distributed. Grasses are important on damp ground as far north as latitude 61°. Weeds, such as dandelion, lady's-mantle, angelica, buttercup, and representatives of other hardy species, flourish nearer the bleak coast and also farther north and at higher altitudes than the birches, willows, and grasses. Large tracts of heath are covered with dwarfed scrub, lichens, and mosses. But the most extensive plant formation of Greenland is that of the fjeld, which in the region of the Norse settlements occurs at altitudes of 900 to 1000 meters. It is a true desert formation: "the plants here do not make a continuous carpet but unite in little clumps or clusters (*Tue*) between which the ground is often bare over large tracts. Not the vegetation but the soil gives the landscape its characteristic appearance."

Nissen adopts Passarge's system of classifying and describing "landscapes." The various elements of a "landscape" are first analyzed in detail one by one. Broader "landscape types" are then established in which the various elements are combined. Finally there follows a description of fourteen individual "landscapes" (we should call them natural regions), the bounds of which are shown on an outline map. The correlation of the "landscape types" and "landscapes" with the settlements in each is then carefully worked out.

Nissen attributes the disappearance of the Norsemen from Greenland to intermingling with the Eskimos. He discounts the theories that they may have died out or returned to Scandinavia or have been exterminated in wars with the Eskimos. He is strongly convinced that the climate of Greenland has remained unchanged and sees no reason why a population established there in the Middle Ages should not have been able to maintain a living by the methods the Norsemen are known to have practiced. The evidence gathered by Nörlund, however, seems to offer positive proof that, in the eastern settlement at least, a change for the worse in the climate actually took place and with it a positive physical degeneration of the people as a result of increasingly hard conditions of life.

History of the Race Problem

Théophile Simar. **Étude critique sur la formation de la doctrine des races au XVIII^e^ siècle et son expansion au XIX^e^ siècle.** 403 pp.; bibliogr., index. *Mémoires Acad. Royale de Belgique, Classe des Lettres et des Sci. Morales et Polit.* Ser. 2, Vol. 16, Fasc. 4, Brussels, 1922.

The author of this paper seems to be engaged with the history of colonial policy in the eighteenth and nineteenth centuries and offers the present memoir as an advance chapter on the history and status of the racial problem in England, France, Germany, Italy, Belgium, and the United States; but, as one turns through the several hundred pages, one discovers that the author has given little more than an outline, that his materials are cited without comprehensive treatment, and that the work as a whole is not well organized. At the outset the author announces his objective as historical; not an inquiry into the phenomena of race, so much as a statement of origins for current beliefs; yet the reader will not go far before coming to suspect that in his own mind the author has solved the problem to his own satisfaction and is engaged in setting the stage for the presentation of his own solution. In other words, he has a racial belief that is fully satisfactory to himself. One suspects this because of bitterness displayed in the citation of contemporary writers on the subject. Again, over and over the author asserts that the doctrines of anthropologists have no part in the formation of these beliefs nor do they enter into the works cited. So the reader is left to surmise that the author's own view of the case is the only one ringing true to anthropology.

Turning now to the positive side of the work under review, we find an opening section on the psychological origins of the race concept which, as an introduction,

is well enough; but the treatment is inconsequential, the main point made being that ethnic groups are conceived as individual entities, which must follow their individual historical evolutions, conditioned in part by the environment and also by their biological characters perpetuated by heredity. The history of the ethnic group concept is an important subject, but the author has not as yet contributed much to our knowledge of it. He conspicuously fails to grasp the nature of the psychological, the biological, and the sociological approach to an understanding of the ethnic group.

This preliminary discussion is followed by the main thesis, which opens with the era of geographical discovery, symbolized by Columbus, and which is taken as the formative period for modern concepts of race, the idea of the author being that contact with subjected primitives stimulated thought on the subject. In this connection also generalities of French social philosophy of the colonial period are enumerated, and some consideration is given to religious thought and missionary activity. Then follows a discussion of anthropology, its development in England and France, followed by a note on the contrast between the spirit of the French Revolution and Imperial England. German thought and philosophy come next into review. The later sections of the work deal with the status of modern thought on the race question, but here as elsewhere the author selects a few names of contemporary writers, briefly but inadequately characterizing their work. For example, his review of American thought is confined to a few bitter denunciations of two or three individuals. Such treatment could give nothing of value to a foreign reader, but it is symptomatic of the whole work.

CLARK WISSLER

CLASSIFICATION AND DISTRIBUTION OF MANKIND

A. C. HADDON. **The Races of Man and Their Distribution.** viii and 201 pp.; diagr., ills., bibliogr., index. The Macmillan Co., New York, 1925. $2.50. 8 x 5½ inches.

Those familiar with Professor A. C. Haddon's useful little book "The Races of Man" (1909) will be delighted to know that he has brought out under the same title a much enlarged and totally new volume. As the title indicates, a basis and scheme of classification for the living peoples of the earth is presented, and the geographical distribution of the racial groups is described. As in his earlier work, Professor Haddon takes for his primary distinction the form of the hair, dividing all the living peoples of the earth into three great divisions according as they are characterized by straight hair (Leiotrichy), wavy hair (Cymotrichy), or woolly hair (Ulotrichy). Further, a grouping by these characters results in the large divisions known as mongoloid, caucasoid, and negroid—the traditional divisions. Haddon, however, groups the various populations of the world according to combinations of the following: hair form, hair color, eye color, skin color, stature, head form, face form, nose form. By the use of these criteria in combination he develops sub-groupings under the three main heads just noted. The job seems to have been done well and therefore calls for no further comment. Every classification yet proposed, except those of the most general sort, has been far from satisfactory, because in the end a large number of living tribes must be placed arbitrarily and because no one has as yet been able to make a clear case of the ancestral relations involved.

Professor Haddon is fully aware of these weaknesses in his own scheme and frankly admits the present impossibility of consistently placing all the known living groups. The outstanding merit of the volume under review, however, is that he has faced his problem in something more than a descriptive fashion, since

in the last chapters we meet with certain suggestions and interpretations directed to the very heart of it. His first proposal is that climate is responsible for the whole thing, that in some way the climatic complex registers on the germ plasm and in isolated areas results in differentiations of feature, color, and form. His basic idea seems to be that climate causes differentiation rather than that any particular variety of climate is correlated with one specific character. This implies that the continued occupation of an area of uniform climatic conditions would be adverse rather than favorable to an evolution of racial types; and, though the author does not so state, he leaves one to infer that the climatic shifts in paleolithic Europe are to be considered as a possible factor in the history of man in that area. But perhaps the most suggestive of the author's proposals are those in which he falls back upon the biological background of man to show good and sufficient reasons why the occasional repetition of a character may be anticipated and also whereby the presence of the intermediate and unclassifiable characters may be accounted for as primitive survivals of reversions and not necessarily as the result of the mixture of breeds. In other words, the picture we get of man evolving tends to conform to biological patterns and not to the mechanical artificial alignments of the old anthropology.

Thus Professor Haddon has not only given us a book that every student of man will put on his reference shelf but, in addition, has formulated a number of fundamental problems that must be considered in contemporary anthropological research.

CLARK WISSLER

A REPORTED MAP OF COLUMBUS

CHARLES DE LA RONCIÈRE. **La Carte de Christophe Colomb.** Map with text in French and English. 42 pp. of each. Éditions Historiques and Édouard Champion, Paris, 1924. 14 x 14 inches.

A little over a year ago there was reported the discovery in Paris of the identical map used by Columbus on his first voyage. This map in colors and also in black and white accompanied by descriptive text in French and English is now before the public.

The discoverer, M. Charles de La Roncière, bases his identification entirely on internal evidence. The map is unsigned and undated. The date is fixed between 1486 and 1492 because the map indicates the southern cape of Africa, discovered in 1486, and fails to show any indication of "America." The maker of the map is successively identified as a student of Ptolemy, a Genoese, and as Columbus, although it is admitted that the writing is not that of the Admiral. His supposed connection with the map is based on inscriptions; one near "Frixlandia," another seemingly taken from the "Imago Mundi," one on the sailing distance to India, one on the Sirens in the Gulf of Guinea, and on the words "Manageta" for Malaguette, and "Agisymba" in South Africa. Because of the supposed date the map is thought to embody the geographical ideas of Columbus at the time of his first voyage. As a final matter of interest it is claimed to reveal, in the island of Antillia, the secret objects of Columbus' first voyage according to the Vignaud theory.

The writer regrets that he cannot agree with M. de La Roncière in his identification. To date the map is not such a simple matter as M. de La Roncière seems to think. It is naïve, at least, to fix the later date limit before 1492 because the map shows no trace of America. This implied that Columbus, who died in the belief that he had reached Asia, would have indicated on his own map another mainland between Europe and Asia. When one considers maps like the Gregorius Reisch, Margarita Philosophica, Friburgi 1503, world maps which failed to show not only the Spanish discoveries but also South Africa and left the Indian Ocean

a closed sea as it had been represented in the earliest Ptolemy maps, one sees that it is not safe to argue too closely as to dates from what is not indicated on a given sixteenth-century map. If a safer course is adopted and one argues from what is on the chart, the date would be put after the Vasco da Gama voyage at least. The map does not have the marked projection of South Africa into the Indian Ocean common to the chart of Henricus Martellus Germanicus and the globes of Behaim and Laon.

It may be granted for argument that the maker of the La Roncière chart was a student of Ptolemy and a Genoese without admitting that he was Columbus. The inscription from the "Imago Mundi" has no necessary connection with Columbus. The mermaid islands appear on the Cosa chart of 1500 and on both the Waldseemüller maps (1507 and 1516) but without the corresponding inscription of the La Roncière map. Columbus had no connection with these maps. The name "Agisymba" appears in a similar place on the Behaim globe and the Bernardus Sylvanus map 1511. As for the argument based on "Manageta" in place of Malaguette, no cartographer who has given painful effort to identifying badly spelled names on sixteenth-century charts would give it much weight. Moreover Managuette is an alternative French form for Malaguette; so the word might point to French influence.

There remains the inscription regarding the distance to India as the sole matter identifying this map with Columbus. Nothing is said in the text about the possibility that Columbus and the chart maker, supposing them to have been different persons, drew from a common source. It would be necessary to prove that nobody but Columbus ever used this particular form of the legend concerning the distance to India, in order to derive value from the argument. Since this is obviously impossible, M. de La Roncière has not done it, and therefore his argument is inconclusive.

If the La Roncière map be examined from the standpoint of Columbian geography as evidenced by his voyages it will be demonstrated that there is no connection between this map and Columbus. Columbus believed that the Ptolemaic estimate of the length of a degree as 66⅔ miles was overvalued. As the writer has tried to show elsewhere (G. E. Nunn: Geographical Conceptions of Columbus, *Amer. Geogr. Soc. Research Ser. No. 14*, 1924) Columbus satisfied himself that a degree equaled 56⅔ miles. Maintaining the 16,000 miles of equatorial distance for the extent of the known world derived from Ptolemy's estimate of 180° in longitude augmented by the 60° called for by the travels of Marco Polo, as shown on the Behaim globe, and dividing by 56⅔ resulted in placing the easternmost point of Asia about 285 degrees east of the Insulae Fortunatae (Canary Islands). Cipangu in turn would be some 30 degrees nearer Europe or about 45 degrees west of the Insulae Fortunatae. Reckoning a degree on the tropic, in round numbers, at 50 miles instead of 56⅔ on the equator, these 45 degrees would represent 2250 Italian nautical miles, or 562½ leagues. Therefore Columbus told his crews, on the first voyage, land would be reached in 750 leagues, allowing sufficient margin apparently to be safe.

Here it is necessary to revert to Vignaud's ideas. Vignaud is led into needless confusion by confounding the geography of Behaim, Columbus, and Marinus of Tyre. Vignaud regards the geographical ideas of all three as identical. They were not. The extent of the known world area represented by Ptolemy and Marinus of Tyre was identical but accounted by the last as 225 degrees in longitude, by Ptolemy as only 180 degrees. Then Behaim was not a follower of Marinus of Tyre, because he represented the mainland of Asia as covering 240 degrees comparing with 225 degrees for Marinus of Tyre. Behaim represented the area depicted by Ptolemy as Ptolemy did—180 degrees in extent. He obtained his 240 by representing what was supposed to be new land. Columbus was not a follower of Behaim.

Behaim and Columbus held different degree values and so represented the same countries under different degrees of longitude. Behaim placed his extreme east of Asia on the 240th degree of longitude which Columbus placed under 285 degrees of longitude.

With these facts and Vignaud's error in mind we are ready to examine the La Roncière map, and at once two things stand out. The Asiatic geography does not at all correspond to the demands of the case. The representation of the south coast of Asia is Ptolemaic, and there is nothing to indicate the great extension of Asia eastwards that is required. The Asiatic coast is made to run northwards with only a very slight additional longitude east of the Ptolemaic lands. There is no Cipangu represented, and Paradise is placed in a different region from where Columbus placed it. According to the La Roncière map Columbus would have had to sail almost half-way around the earth to reach Asia. The alternative, another objective, is ridiculous. The Island of the Seven Cities located in a region he never approached and in a direction he never sailed on any of his four voyages is made the secret objective of the Admiral. Columbus sailed west from the Canaries on his first voyage. He showed some signs of hesitation when about 400 leagues west of the Canaries and looked for land, but when it could not be found he went confidently westwards again. The next uncertainty arose when 800 leagues had been passed without reaching Cipangu, supposed to lie across his path. When 1100 leagues had been passed and he found Cuba it corresponded in position fairly accurately with the mainland of Asia. Then Santo Domingo was identified by the Admiral as Cipangu, but its main axis lay east and west instead of north and south. That is why the Admiral missed finding it on his outward voyage. All of Columbus' voyages are understandable in the light of his actions and the accounts we have of them on the basis of the above geographical concept. The Island of the Seven Cities located far to the north of the Azores while Columbus sailed several hundred miles south of them definitely proves that this particular island could not have been the object of his search. It also hardly need be argued that the map cannot be the Admiral's map in the light of what has been said. It remains for the world no more than it was before M. de La Roncière gave it an undeserved notice, a portolan chart of the sixteenth century.

GEORGE E. NUNN

INTERNAL TIDES OF SEAS AND ATMOSPHERE AND THEIR EFFECTS

O. PETTERSSON. **Innere Bewegungen in den Zwischenschichten des Meeres und der Atmosphäre.** 43 pp.; maps, diagrs., ills. *Nova Acta Reg. Soc. Sci. Upsaliensis*, Ser. 4, Vol. 6, 1923, No. 2. Upsala.

The effect of the moon on the earth is usually thought of simply in terms of ocean tide production as shown by the flood and ebb of the surface waters. Little are the internal tides of the ocean appreciated, and still less are tidal forces considered in the category of the important factors of climatic control. But consider what Dr. Otto Pettersson has found. First of all he shows that in the Skagerrak there are tides and marked changes in level in the surface of the Atlantic water under the brackish Baltic outflow. These tides show in a 1-to-3-meter vertical oscillation of the surface of 30-per-1000 salinity, usually found at a depth of 10 to 20 meters. The surface of the sea has a tide of but a small fraction of a meter. The subsurface tide merely changes the speed of outflow of the surface layer. The depth at which a salinity as great as 30 per 1000 is found varies to a large extent with the position of the moon. These internal tides are most pronounced near the autumnal equinox every third year (1922, 1925, etc.) when new or full moon occurs with perigee while the moon is on the plane of the ecliptic, or at "node-apside" as Dr. Pettersson names

it. Great tidal floods sometimes occur, as that of 1.7 to 2 meters on Dec. 4, 1914, in Christiania Fiord and on the west coast of Sweden, when a seiche, induced by a strong low and augmented by an onshore gale, coincided with a spring tide. It is not difficult to appreciate why there were such great flood tides in the fourteenth and fifteenth centuries when the node-apside coincided with perihelian.

Similarly, though the atmospheric tide is extremely minute, there appear to be large inner waves produced by lunar influences on internal boundaries in the atmosphere. The circular oscillatory wave motion, combined with the deflective effect of the earth's rotation should produce cyclones over the smooth surface of the North Atlantic. Lunar periods are such as to bring major tidal effects at intervals of 3, 8, 9, 10, 18, 36, 54, 84–93, 176–185, and about 1850 years. Since the peak effects of these periods have come in autumn or early winter during the last few centuries, their expressions should be found in the characters of winters. There is, for example, a noteworthy 8-year period of mild and severe winters. The 140-year New Haven temperature record stands out even more clearly than the European ones, there being an almost unbroken series of mild winters every 8th year from 1788 to 1922. Others can be recognized as climatic as well as hydrographic periods. This is especially true of the 9-year and 10-year periods in the winter temperatures of Stockholm and Berlin since about 1760. But the repetitions come and go, for the coincidence of certain lunar periods with one another is not exact. Thus, after decades of being practically in step they fall out of step, only many years later to get back into step again. In the meantime, however, other combinations have taken up the 8-, 9-, or 10-year rhythms. So at practically all times there are two or more of each of these traceable. The period of instrumental observation is not long enough to establish the presence of the longer periods, though that of 180 years is strongly suggested, with the minimum about 1822 and with the 70 years before and after averaging the same. A record of ice break-up in Lake Mälaren, from 1712 on, corresponds to conclusions reached from the somewhat shorter instrumental records. The temperatures of London since 1764 have also corresponded to those of Berlin and Stockholm in showing the lunar periods in the same phase. So do the ice record of the Neva River and the sea temperature of western Norway. Vienna, however, is not in parallel.

The 1850- or 1900-year period of the coincidence between node-apside and perihelian has been fully discussed in an earlier monograph (reviewed by Ellsworth Huntington in *Geogr. Rev.*, Vol. 1, 1916, pp. 196–201). In this more recent paper Dr. Pettersson summarizes his arguments, adds some further details, and answers criticisms.

CHARLES F. BROOKS

EARTHQUAKES AND EARTHQUAKE LORE

F. DE MONTESSUS DE BALLORE. **La géologie sismologique: Les tremblements de terre.** xiv and 488 pp.; maps, diagrs., ills., indexes. Librairie Armand Colin, Paris, 1924. 50 fr. 10 x 6½ inches.

F. DE MONTESSUS DE BALLORE. **Ethnographie sismique et volcanique ou les tremblements de terre et les volcans dans la religion, la morale, la mythologie et le folklore de tous les peuples.** vii and 206 pp.; indexes. Edouard Champion, Paris, 1923. 10 x 6½ inches.

The three volumes, "Les tremblements de terre: Géographie séismologique" (1906), "La science séismologique" (1907), and "La géologie sismologique," make up the most complete treatise on earthquakes that has so far appeared, and they form a fitting monument to the work of the distinguished author (see obituary notice in the *Geogr. Rev.*, Vol. 13, 1923, p. 633).

The present volume may be divided into three parts: a short introduction classifying earthquakes; the main part, giving descriptions of many earthquakes, es-

pecially the earth movements affecting the topography; and a final chapter on the distribution of earthquakes.

The author classes earthquakes as (1) glyptogenic, or geologic, and (2) external dynamic. He points out that the second group, which comprises volcanic and downfall shocks, is quite unimportant. All the great shocks belong to the first group, which he again divides into tectonic and epirogenic, according as they are due to movements, largely horizontal, connected with the folding of the rocks, or to the general elevation or depression of large continental areas; and he adds a third group consisting of a combination of these two. In his "Géographie" he found that 95 per cent of the earthquakes of his immense catalogue occurred in two zones which coincided with the Mesozoic synclines, regions which have been folded and in places raised into the greatest of our mountain chains; and he was led to the empiric law that the folded structure of the geosynclinals is unstable and that the tabular structure of continental plateaus is stable. He knew that this law was not universal; and further consideration of earthquakes like the New Madrid, the Charleston, those of northern China, and others outside of these geosynclines led to the introduction of his epirogenic class. The value of this classification may be questioned, especially as the author finds it often difficult to decide into which class a particular earthquake should be put. He regards earthquakes as due to the weakened survival of forces which caused the relief of the earth's surface; but may not these forces in some regions be as strong as they ever were?

The California earthquake of 1906 made it clear that earthquakes are due to earth movements; recognizing this, Count de Montessus has collected, in the main part of his books, accounts of earthquakes that have been accompanied by serious changes in the topography, and he attempts to distinguish between the real earth movements and the slumping of loose material. These descriptions with maps and illustrations will be of great value, for the original accounts are in many cases difficult of access.

A few chapters are devoted to secondary effects, such as landslides, mud flows, the influence of the geologic foundation on intensity, etc.; and then follows the last chapter of eighteen pages on the distribution of earthquakes—a chapter of special interest, for in this branch of seismology De Montessus had led the world. In his "Géographie" he had studied the distribution of earthquakes occurring on land or very close to it. He now examines the distribution of 881 strong earthquakes recorded by Milne seismographs in 1899–1909, whose origins had been determined from the seismographic records. He finds that 74 per cent occurred under the water, and this is closely the ratio of the water area to the whole area of the earth; therefore he concludes that earthquakes are not influenced by land or water. The conclusion is probably correct, but its basis is not satisfactory, for earthquakes are not scattered promiscuously but are to a large extent localized in special regions. Milne's earlier catalogue of destructive earthquakes, all occurring on or close to the land, recorded an average of 31 annually; and Milne estimated that about 30,000 perceptible earthquakes occurred every year, or 1000 for every violent shock. Applying the same ratio to the 881 violent shocks recorded for the whole earth, land and water, in eleven years, De Montessus concludes that about 80,000 shocks strong enough to be felt near their origins occur every year. The 881 shocks are largely concentrated in groups—near the end of Kamchatka, east of Japan, from the coast of China southward through the Philippines to New Guinea, northeast of New Guinea (though the island itself seems to be almost exempt), and again farther east. These are the regions of the earth that are most unstable seismically. The mesozoic geosyncline is supposed to trend south through New Zealand; but only a few shocks were recorded in that region, whereas south of Australia is a region of strong shocks. So De Montessus thinks that his former law will have to be modified.

In his patient collection of earthquake data Count de Montessus de Ballore accumulated a vast mass of information on the popular ideas of seismic and volcanic phenomena—fables, myths, and folklore tales. These he brought together in his "Ethnographie sismique et volcanique . . . " They come from many parts of the world and show how strongly these scourges have impressed the human mind. They have one characteristic in common, namely, they show the tendency to ascribe to the supernatural anything that is not understood; a tendency which has not yet, by any means, disappeared. Many legends ascribe earthquakes and volcanic outbursts merely to the bad tempers of the gods or the demons, or to quarrels between them; many assume that the phenomena are sent as punishments; some look upon them as portents.

It is with deep regret that we close these volumes and realize that we shall have nothing more from the pen of the author, who has added so much to our knowledge of earthquakes.

HARRY FIELDING REID

GRAPHIC ILLUSTRATION IN EARTH SCIENCE

A. K. LOBECK. **Block Diagrams and Other Graphic Methods Used in Geology and Geography.** xi and 206 pp.; maps, diagrs., ills., bibliogr., index. John Wiley and Sons, Inc., New York; Chapman & Hall, Ltd., London, 1924. $4.50. 8½ x 11 inches.

To say that Professor Lobeck's book on "Block Diagrams" is the best work of its kind would be inadequate. It is the *only* work of its kind and a most excellent work at that. For curious though it may seem, the greatly extended use of block diagrams has up to the present inspired no book on the methods of drawing them. Professor Davis, who gave currency to this most valuable form of illustration by employing it extensively in his writings with a skill not previously attained, gives only occasional suggestions on construction, as those incorporated in his "Erklärende Beschreibung der Landformen." Lobeck's work, therefore, supplies a long-felt want and supplies it in such manner as to place all geologists and geographers greatly in his debt.

After a brief introductory account dealing with the general nature and uses of block diagrams, the author devotes two chapters to the methods of drawing rectangular blocks in one-point and two-point perspective. Directions for correctly transferring geological cross sections to the exposed sides of the blocks, for exposing cross sections within the blocks, for transferring data from topographic quadrangles directly to blocks, and other useful information are given; while the results of erroneous methods are ingeniously shown in blocks incorrectly drawn.

Once the student has mastered the art of drawing simple blocks of different types, he is ready to carve in those blocks the varied forms of the earth's surface. To aid him specific directions are given in a series of chapters describing methods of representing plains and plateaus in different stages of dissection; dome, folded, block, and complex mountains; volcanoes; and the forms especially characteristic of stream, glacial, and wave erosion. Simpler forms are discussed first, and progress toward more complicated features is gradual, with successive drawings to aid the student at each step in his advance. The sense of realism is heightened by making many of the blocks represent actual parts of the earth's surface, most frequently the areas of specific quadrangles of the United States topographic map. But foreign maps are also employed as the basis for expressive diagrams, while references are given to additional maps from which the student may construct original diagrams similar to those in the text.

So much for the major portion of the work. The usefulness of the book is broadened by the addition of a discussion on "isometric diagrams and problems in struc-

tural geology"; a section devoted to special methods to be used in constructing more elaborate block and other physiographic diagrams, illustrated by particularly excellent specimens of the author's art; and finally one section each on landscape sketching and on crystal drawing.

In a work so excellent it is perhaps ungracious to dwell on minor imperfections. Yet the critical reader might suggest a few improvements for a new edition, to the end that all parts of the volume may be raised to the same high level. The chapter on volcanoes is disappointing. Here we find nothing of the author's own creation, but only copies of work by others, for the most part wholly unlike anything in the preceding part of the text. The contrast is abrupt and disconcerting, for even the diagrams by Davis are of a different style from those by the author, while the bird's-eye view of Cinder Cone and the maps of the Azores do not seem to fit well into the scheme of treatment at this point. Slips of lesser importance are found in Figure 58, where plateaus in late youth or submaturity (*B* and *E*) are called "mature" and where impossible conditions as to successive depths of stream cutting are represented (*D*, *E*, *F*); in Figure 63, where again a submature plateau is called mature, although the text makes clear the impropriety of the term; in Figure 68, where what appears to be an overlapping portion of the coastal plain is apparently incorrectly labeled "Oldland"; on page 97, where the definition of a mature stream needs revision, and the statement that "none of our large rivers have passed beyond the mature stage" seems to need rephrasing to make clear the fact that streams which are at least late-mature are fairly common; on page 110 and in Figures 160–162, where the youth and maturity of cirques are confused with the youth and maturity of the mountain mass in which the cirques are cut, and where the term *arête* is incorrectly spelled in a number of places.

These are, however, mere matters of detail. The only question of principle likely to provoke difference of opinion is the extent to which devices of mechanical drawing are introduced as an aid to depicting the highly variable forms of nature. Some may feel, for example, that since river curves seldom, if ever, approach segments of circles of uniform diameter, the scheme of drawing river curves outlined on pages 29–31 is of doubtful value and might well give place to greater emphasis on the suggestions for free-hand sketching of river curves. Certainly the use of the ellipse as an aid to drawing alluvial cones does not give happy results (Figs. 112, 113). The cones give an impression of rigidity, of failure to extend laterally the normal distance, and of lacking the slightly concave (upward) profile characteristic of these forms; while the wave-formed terrace (Fig. 112 C) based on subsidiary ellipses seems unnatural because it shows wave cutting only and does not represent the equally important wave-built part of the terrace, formed of the eroded débris. Perhaps it sufficiently answers this criticism to say that any student who masters the more rigid geometrical forms will be able to produce passable diagrams even if he is endowed with no artistic ability; while the man of artistic talent will quickly advance to such free-hand modifications of the cruder forms as will make of them realistic representations of nature. In any case it would help if the author would add one further stage to more of the avowedly "rough sketches" in order to show, as he has beautifully done in Figure 139 and elsewhere, a freer handling of the subject.

DOUGLAS JOHNSON

THE GEOGRAPHY OF ART

KURT GERSTENBERG. **Ideen zu einer Kunstgeographie Europas.** (Bibliothek der Kunstgeschichte, edited by Hans Tietze, Vol. 48–49.) 28 pp.; ills. E. A. Seemann, Leipzig, 1922. M. 2 gold. 7 x 5 inches.

A professor of the history of art at the University of Halle advocates a new method of studying art, a method which he calls "Kunstgeographie," or the geography of

art. From the geographer's point of view "Kunstgeographie" is one aspect of human geography. Now, human geography is certainly not an exact science; perhaps in its present stage of development it is not even a science at all. It has, however, developed beyond the point where broad generalizations should be made in it without circumspection. This is where the outsider (not to speak of the geographer himself) who ventures into this field should be on his guard. The historian of art should ponder long before correlating the facts of art, about which presumably he knows something, with geographical facts and processes and probabilities with which he cannot be any too familiar.

In some places it is hard not to feel that Gerstenberg draws a pretty long bow in his generalizations, and elsewhere we are conscious of that disturbing sense of inconsistency all too common in books on anthropogeography. If we agree with Gerstenberg that the seas tend to exert a unifying influence upon the art around their shores, we cannot help wondering whether great rivers really *do* tend to form boundaries between different regions of artistic style owing to the swamps and forests along their courses. Natural influences, argues Gerstenberg on page 4, are more potent than political forces in determining the regional relations between artistic styles and groups of styles. On page 10 he asserts that the Alps have never been an "art-geographical" boundary between Italy and Germany; that the Apennines mark the true frontier between the region of pure Italian art and that which has undergone Teutonic influence. Doubtless these facts are true enough, but they do not seem to jibe with the argument on page 4. The Apennines are certainly not as mighty a natural frontier as the Alps. We have a suspicion that the reason why Germanic influence is marked in the Po valley has something to do with the cultural relations that existed in the Middle Ages between that region and southern Germany and that the latter had a great deal to do with the Holy Roman Empire, a political organization which straddled the Alps. Might it not be argued that political influence upon art was here stronger than that of natural environment?

However this may be, Gerstenberg's central idea is an original and useful one, capable of further development, and his statements of fact regarding the distribution of art and the nature of its dissemination are probably reasonably accurate. He is quite right in asserting that maps showing the distribution of styles of art should not be omitted—as they nearly always are—from large atlases, any more than maps showing the distribution of languages and religions, manifestations of the human spirit no more important than art. Perhaps the practical difficulties of discriminating between styles are greater than Gerstenberg would have us believe, and regions characterized by a broad uniformity in the forms of all the arts ("Kunstgemeinschaften") are somewhat more illusory than he thinks. There will always be more room for disagreement here than in the case of religious and linguistic regions. It should not, however, be impossible to mark off such regions, and we are quite ready to believe that Gerstenberg's attempt to do so falls somewhere near the truth.

He traces five zones each characterized by a distinctive "Kunstgemeinschaft" running in a southwest and northeast direction across Europe. The first zone includes Normandy, Britain, Iceland, and Norway; the second, in which Hanseatic influences were felt, takes in Flanders, Holland, Denmark, the north German coast, and Baltic provinces; the third lies at the interior of the coastal zone, running eastward from central Germany into Poland and westward into France; it is sharply marked off on the south from the fourth zone which betokens the proximity of the mountains and includes Switzerland, South Germany, German Austria, and Bohemia. The fifth zone, that of northern Italy, would seem to have many affinities with the second, or northern coastal zone. We are left in doubt regarding Spain, central and southern Italy, and the Balkan Peninsula.

CORRESPONDENCE

Another letter received from Colonel Fawcett is dated Bakairi Post, Matto Grosso, May 20 (see the July number of the *Review*, p. 520). The position of the post is latitude 14° 15′ S., longitude 54° 32′ W.; the altitude is 1480 feet. Extracts follow:

With vicissitudes of various kinds incidental to these localities of shocking trails and extremely sparse population the expedition has reached this point at the end of civilization in Matto Grosso and in touch with the Indians. The three of us are well and fit. In two days we leave here with two peons for the north. Five days later we shall have reached the point beyond which the peons will not go, for they have an abiding terror of the aborigines. From there the three of us will pursue the journey with six of the best animals, hoping that it will be possible to make use of them for at least a month. Not even the Indians of the Xingú who come here in small parties now and again know what exists away from the rivers. The Indians of the western side and the Tapajóz seem to be better informed, owing possibly to their contact with the Caxabis, a large and aggressive nation of bright copper people who inhabit the vicinity of the Paranatinga and Arinos Rivers. It is the bright copper people who seem to be so much more advanced in art and so suggestive of a superior origin. A party of Minácо Indians from the Xingú is here at present, but I can extract little out of them. They are a brown people, that is nearer the original Tupi, carrying as is usual with the brown types a strong suggestion of the Turanian race. The Xingú Indians are easily recognizable, for all cut the hair in a sort of mop form with a two inch tonsure, the origin of which is obscure.

The Bakairis have been dying out ever since they became civilized. There are only about 150 of them. Small parties of Xingú Indians from the Nahagua and Minácо come occasionally for what they can get and are a much finer people. Rubber gatherers and Caxabi still kill one another in the Paranatinga. From the east the cowardly Caiapo Indians, a stick-throwing lot, raid the plantations, kill when they can, and inspire much terror. Bakairi Post seems to me to present a first-class field for American or British missionary enterprise—a medical missionary. At this altitude it is potentially healthy, not too hot, and much excellent work could be done. Most probably contact could be gradually made with the remoter tribes.

We expect to be on the edge of the old civilization in a month from now and hope to reach its focus by the end of August. It certainly is a most interesting field of research if only for its geographical character and the intriguing nature of the inhabitants. But the insects are discouraging. Even here the flies are a nuisance, and we are literally covered from head to foot with itchy tick bites, mainly the tiny ones about half the sectional area of a small needle.

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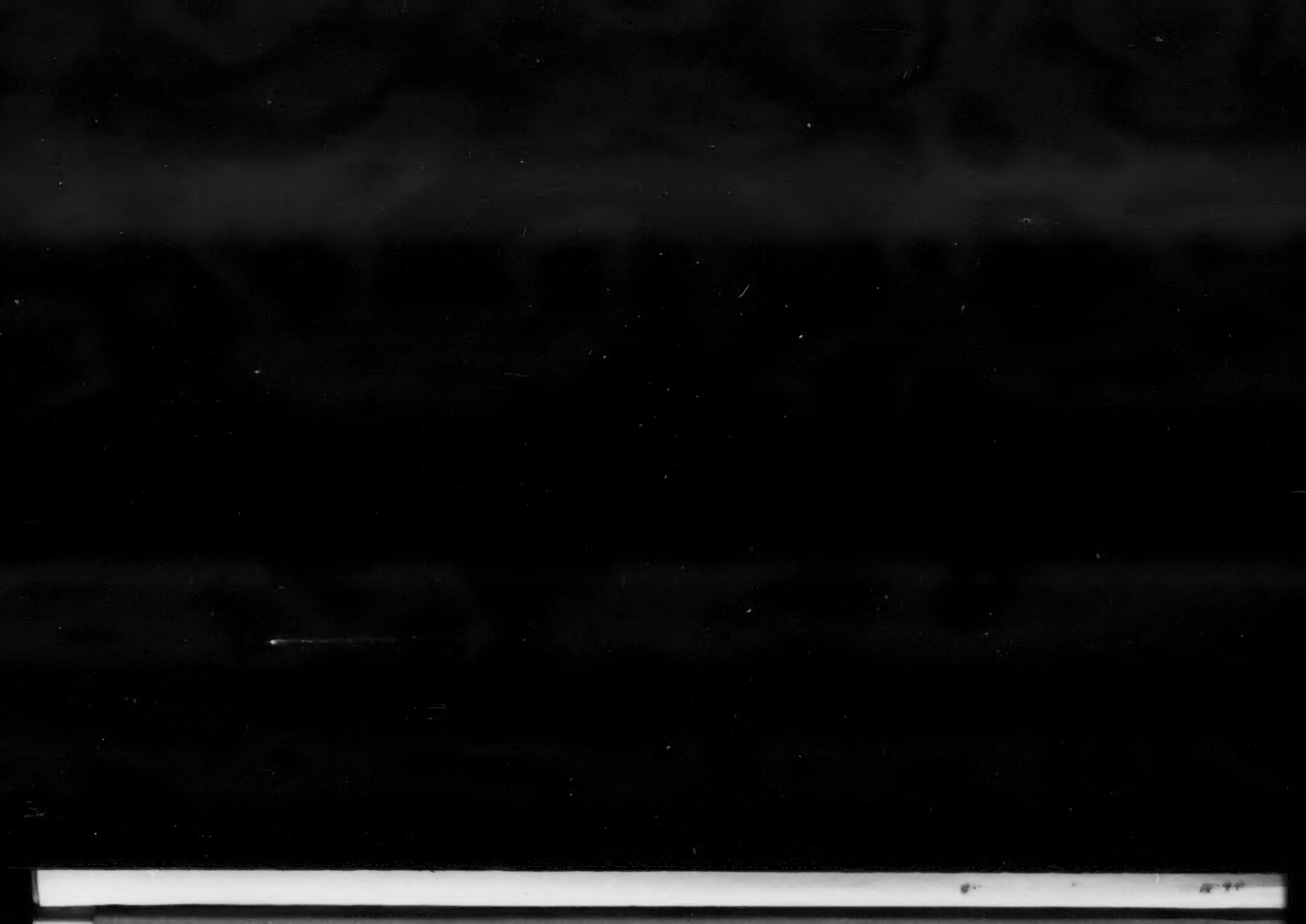
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